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ABSTRACT

This resource book is intended to help teachers and schools enhance their teaching of thinking, and to make their teaching of thinking skills more deliberate, explicit, and an integral part of the school curricula. It challenges all educators to reflect on their involvement in teaching for thinking, teaching of thinking, and teaching about thinking. Chapter 1 offers a rationale for teaching thinking skills and defines the skillful thinker. Chapter 2 outlines roles of teachers, administrators, and students in developing a climate where thinking skill development can flourish. Chapter 3 suggests how an effective approach to teaching thinking can be implemented in a school community. Specific student activities are the major emphasis of chapter 4. Chapter 5 offers suggestions for evaluating thinking. An afterword, glossary of terms, 50 references, and extensive appendixes (including classroom and teacher planning materials) conclude the resource guide. (SR)

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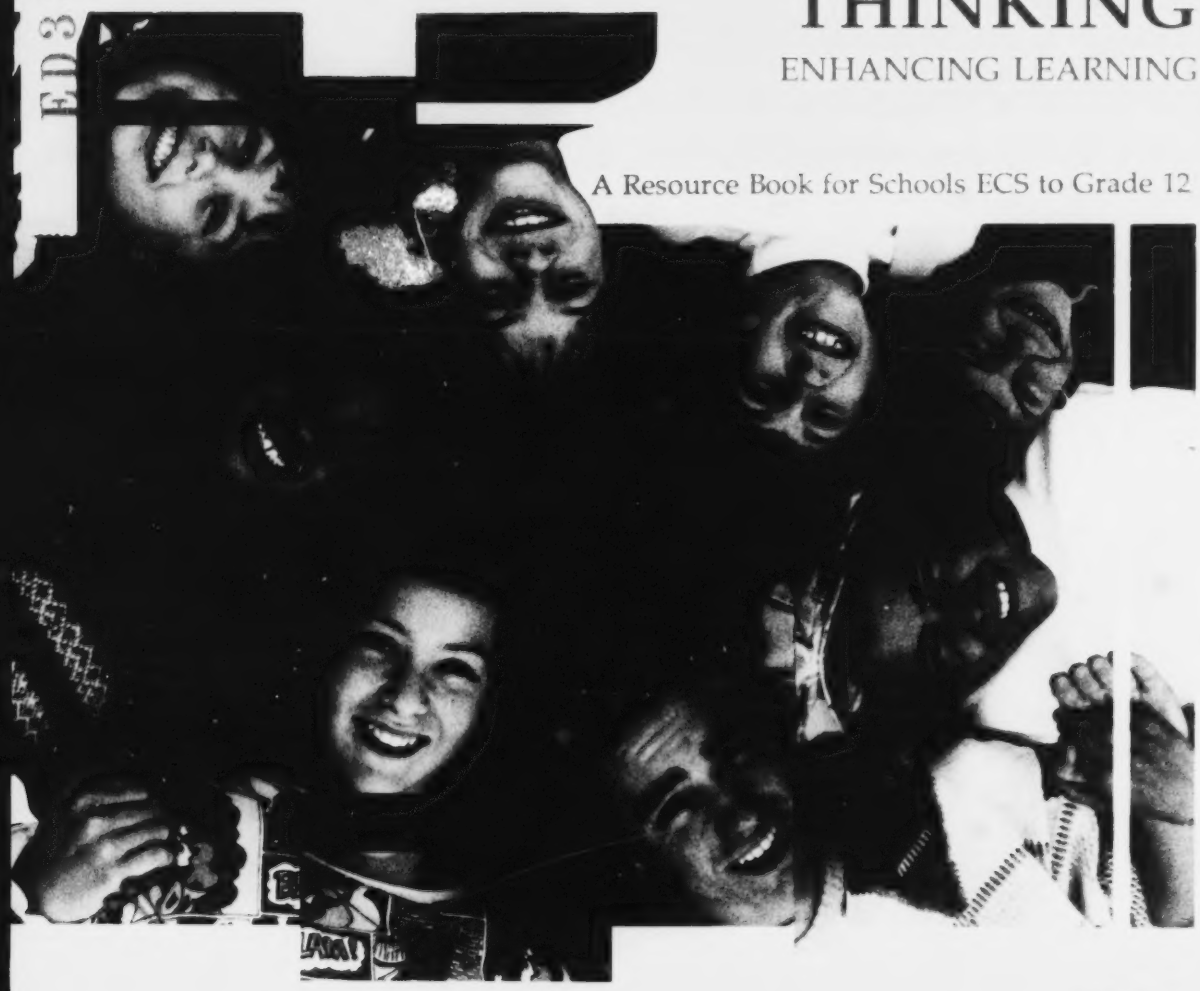
TEACHING THINKING

ENHANCING LEARNING

A Resource Book for Schools ECS to Grade 12



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A Resource Book for Schools

ECS to Grade 12

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INTRODUCTION

In 1989, Alberta Education distributed a discussion paper on teaching thinking. The responses from educators throughout the province indicated that a resource was needed to help teachers and schools focus on teaching thinking. This document, based on the discussion paper's guiding principles, challenges all educators to reflect on their involvement in . . .

Teaching *for* Thinking*

- creating classroom and school environments conducive to full cognitive development
- providing a supportive, thoughtful environment by modelling thoughtful behaviour
- developing positive attitudes toward thinking

Teaching *of* Thinking

- developing information processing skills by directly teaching learning thinking strategies
- developing logical, critical problem-solving and decision-making skills
- developing creative, lateral, explorative and expressive skills

Teaching *about* Thinking

- developing metacognitive awareness about students' own and other' thinking processes
- developing students' awareness of how cognitive processes can be applied in real-life problems and situations
- sharing knowledge about great thinkers and good thinking.

*The reference to teaching *for*, *of* and *about* thinking has been suggested by Dr. Arthur Costa (1985) and presented (1988) at the "Thinking, . . . for a Change" conference, Edmonton (1988).

In our society's transition from an industrial to an information base, we must re-examine the role schools play in nurturing the development of young people's ability to think. The challenges of the future will require a full measure of imagination, reason and empathy. We must help students become thoughtful and creative adults who have the cognitive processes to meet these challenges.

Guiding Principles

This document, *Teaching Thinking: Enhancing Learning*, explores ways to cultivate thinking in schools. Thinking and learning are what education is all about. How can educators support and promote growth and development in these areas? That is the main focus of this document. The following guiding principles are a starting point from which educators might explore ways to enhance their teaching of thinking.

1. **Students can improve their thinking skills.**
2. **Students should have opportunities to improve their thinking skills.**
3. **Educators should instruct students in thinking skills.**
4. **Educators should use a range of strategies in teaching thinking skills.**
5. **Educators should make use of life experiences and school subjects in teaching thinking skills.**
6. **Educators should have opportunities to learn about thinking as well as how to teach thinking.**
7. **Educators should use appropriate evaluation techniques to assess thinking skills.**
8. **Administrators can and should ensure positive attitudes toward thinking in schools.**
9. **Alberta Education should make explicit the teaching of thinking in curricular documents.**

Each of these principles holds much promise for the teaching of thinking skills. Collectively, they form a comprehensive package of even greater promise. (For a detailed description of these principles, see Appendix L.) Based on these guiding principles, this document emphasizes the teaching of thinking skills as an integral part of the school curricula, not as an isolated endeavour. Thus the thinking skills required for particular content areas will be addressed in a meaningful context. This explicit usage in the context of curricula is illustrated with examples throughout the document.

Teaching thinking in the context of school subjects also has implications for how students transfer their new thinking skills. For example, students should be encouraged to see the relationships between thinking skills used in mathematics and those used in social studies. There is abundant evidence that the long-term benefits of learning thinking skills are much greater when they are integrated within subjects and across the curriculum (Resnick 1990; Sternberg 1986).

Teaching Thinking: Enhancing Learning explores how this approach to teaching thinking can be addressed in schools. Chapter I offers a rationale for teaching thinking skills and defines the skilful thinker. Chapter II outlines roles of teachers, administrators and students in developing a climate where thinking skill development can flourish. Chapter III suggests how an effective approach to teaching thinking can be implemented in a school community. The major emphasis of Chapter IV is specific student activities. Readers can select chapters of particular interest to them or read through the document for a more complete picture of educating "for, of and about thinking." Finally, Chapter V offers suggestions for evaluating thinking. The appendices can be photocopied.

The explicit teaching of thinking skills across the curriculum presents exciting possibilities for teachers. This resource document encourages teachers to explore how thinking skills can be taught in their classrooms. They are invited to enhance the ideas presented and to experiment with their own ideas for teaching thinking.

During a workshop series on how learning can be enhanced through teaching, one teacher described her feelings in this way:

I'm excited about my own thinking and my teaching is revolutionized. Kids are having more fun, working harder and I am talking less, listening more, during class.

Students' responses excite me. I am enthused and encouraged by their creativity. They like to see that they have ideas. Weak, non-productive students are coming up with creative responses and ideas. Self-esteem is rising (one of my original goals for them).

Most important, these inservices have provided the key for my career longevity . . . thinking skills make everything relevant . . . content becomes a vehicle . . . thinking, creativity, self-esteem is the result.

Grade 10 Teacher

It is our hope that this document will help all educators explore the benefits, for students and teachers, of teaching thinking.

CHAPTER I:

ABOUT THINKING AND THINKERS

This chapter defines thinking and the skilful thinker and provides reasons why we teach thinking skills.

What Is Thinking?

Some educators define thinking as a set of skills, such as generating multiple solutions to a problem or interpreting information and assessing multiple perspectives. This document uses a broad working definition of thinking as:

> ***...the mental processes and skills we use to shape our lives.***

This definition moves beyond a description of critical and creative skills and processes, by implicitly acknowledging the varied and personal nature of thinking. This document focusses on how students can further develop the thinking skills they use in shaping their lives, both in and out of school.

To many students, thinking is just something to do. Students who have had two or three years of focussing on the nature of their thinking and how to improve it express it this way:

Thinking is the act of letting an idea, problem or thought fumble and turn, seeing the facts or issues and using the six thinking hats to understand the issues.

Fred, Grade 6 student

Thinking is what nature hired the mind to do.

Ryan, Grade 5 student

Thinking is partly looking over and analysing things you already know, and partly trying to figure things out.

Clayton, Grade 4 student

What Are the Characteristics of a Skilful Thinker?

Roger von Oech, in his book *A Kick in the Seat of the Pants* (1986), provides insight for the direction of teaching thinking. He describes ideal thinkers as possessing mental flexibility.

Like race car drivers who shift in and out of different gears depending on where they are on the course, creative people are able to shift in and out of different types of thinking depending on the needs of the situation at hand. Sometimes they're open and probing, and at others they're playful and off-the-wall. At still other times, they're critical and faultfinding. And finally, they're doggedly persistent in striving to reach their goals. (p.15)

Our expectations for teaching thinking can be described in terms of the attitudes that can be cultivated in students. These expectations are expressed in the following goal statements.

1. **To develop an inclination toward thinking, through**
   - interest in the sources of personal attitudes, beliefs and values
   - curiosity about personal thinking processes and an eagerness to further the processes of planning, monitoring and refining thinking

- willingness to learn from mistakes, including taking risks and subjecting ideas to scrutiny
- sensitivity to new ideas, problems and issues
- understanding and respect for novelty and intuition
- exploring ideas beyond what is presented—a "let's find out" attitude
- a desire to reason well and base judgments on evidence
- striving for persistence and accuracy
- becoming more reflective in thinking.

2. **To enhance the gathering, conceptualization, reconstruction and application of information in meaningful contexts, through**
   - retrieving information from multilevel and varied sources
   - associating past ideas and experiences
   - searching for meaningful patterns and relationships among concepts
   - extracting new information, reconceptualizing existing knowledge and creating new meanings
   - applying and expressing reconceptualized information in a variety of ways
   - planning, evaluating and monitoring thinking, which includes altering goals and strategies when information and processes are incongruent.

3. **To enhance the production of original responses, ideas, solutions and actions, by**
   - remaining open and deferring judgment
   - producing many ideas with ease
   - shifting perspectives while producing ideas
   - combining ideas in novel and unusual ways
   - embellishing or adding details to ideas to enhance meaning and interest.

4. **To enhance evaluation of ideas, decision making, problem solving and resolution of issues, through**
   - seeking information from several viewpoints
   - generating, selecting and applying criteria for evaluation
   - testing, interpreting and verifying data and criteria
   - recognizing unstated assumptions, fallacies and bias
   - approaching decision making, problem solving and issue resolution systematically
   - recognizing when evidence is insufficient
   - increasing thoughtful reflection
   - setting personal standards for evaluating "effective thinking."

5. **To demonstrate confidence and satisfaction in solving problems individually and collectively, through**
   - an interest in the attitudes, beliefs and values of others
   - the ability to empathize and respond to others
   - a sense of humour and social understanding
   - a willingness to entertain opposing viewpoints
   - communicating precisely and being able to express another's point of view accurately.

Researchers have identified the four prevalent dispositions individuals can experience as thinkers. They exemplify thinking and life goals for all learners and can be synthesized as follows:

Thinkers are Discoverers in their search for information, seeking new concepts, experiences and feelings. They search for various kinds of information.

Thinkers are Creators, who rearrange information, change patterns of connection and experiment with a variety of approaches. They create and transform ideas in their own way.

Thinkers are Evaluators who generate criteria, analyse risks, test assumptions and bias and follow intuition. By compiling information and critically weighing the evidence, they make decisions on whether or not to implement, modify or change a course of action or an idea.

Thinkers are Performers, taking ideas into action. A performer is tenacious and executes strategies successfully. Through planning, goal setting and visualizing, performers make the most efficient use of time and resources. They find ways to overcome obstacles and achieve their goals.

These four attitudes outline a process of successful thinking and draw particular attention to the need for developing effective thinking programming. Together, teachers, students and school communities must explore, synthesize, evaluate and implement their program in phases, as there is no one method or program that will suit all students and teachers.

Why Teach Thinking Skills?

In many classrooms across the province of Alberta, teachers are challenging students to think. The purpose of this resource document is to support and extend the deliberate teaching of thinking skills. Some of the reasons for this emphasis on thinking skill development are:

- New findings in research about thinking.

Recent evidence suggests students can be challenged to engage in more complex thinking through the explicit teaching of thinking skills. Research also indicates students' thinking can become more effective and focussed once they reflect on their thinking processes.

- The transition to the age of information.

Rapid advances in information and communication technology have created new job opportunities that require complex thinking skills. With increased access to ever-expanding bodies of knowledge, students will need critical, creative thinking and problem-solving skills to resolve the complex political, economic and social issues they face.

- Changing view of learning in teaching.

As students gain increased access to information, the emphasis in teaching will continue to shift from dispensing knowledge at the front of a class to working with students as guides and mentors in the adventure of learning. The teaching of thinking skills represents an invitation to students to be active participants in the learning process.

The overall goal of teaching thinking skills is to develop autonomous learners. This is a marked change from being a directed or reproductive thinker and implies changes in the traditional roles of the student and teacher. The student is required to take more responsibility for learning and thinking, through goal clarification, obtaining valid information and analysing courses of action. The student's role involves actively structuring and evaluating his or her thinking. The teacher's role changes from being a director of thinking to a facilitator of learning and thinking. Some characteristics of the changing roles are depicted in Tables 1 and 2.

Table 1

CHANGING ROLE OF STUDENT

REPRODUCTIVE THINKER	AUTONOMOUS THINKER
• reproducing knowledge	• creating and discovering knowledge
• passive recipient	• active decision maker
• convergent, rule abiding	• divergent, steps outside of rules to create original ideas
• information narrowly focussed	• information broadly focussed and interrelated
• one right answer	• multiple solutions
• mistakes are flaws	• mistakes are learning devices
• external evaluation and direction	• self-evaluation, self-direction
• individualistic, competitive	• collaborative

Table 2

CHANGING ROLE OF TEACHER

DIRECTIVE THINKING	FACILITATIVE THINKING
• provision of knowledge	• construction of knowledge
• disseminator	• mediator, collaborator
• content focus	• process focus
• information narrowly focussed	• information broadly focussed and interrelated
• general student assessment based on common standards	• assessment of student as an individual learner
• common instruction	• accommodation of learner differences

CHAPTER II

A CLIMATE FOR THINKING IN SCHOOLS

The purpose of this chapter is to describe the characteristics of a climate where thinking skills can flourish and to outline the roles teachers, students and administrators can play in creating such a climate in their school.

Creating a Climate for Thinking

A teacher's thinking is an invisible yet powerful force that drives student performance and thus affects the learning climate. It is important then that conditions in the learning environment stimulate the thinking of teachers as well as the students. Aspects of school and classroom conducive to thinking are:

openness:	joy and respect for unusual ideas, unique responses and outlandish questions; encouragement of original thought.
stimulation:	discussion of paradoxes, problems and dilemmas; opportunity to collaborate and resolve issues and problems; use of enriching resources that stimulate inquiry.
time:	reflection and pondering on ideas; experimentation with "wait" time; allowance to make mistakes and take risks; opportunity to examine and reflect on the processes of one's own thinking.
freedom:	opportunity to predict and suppose, pose and explore possibilities; in-depth investigation of topics that involve many areas of study; sharing of new ideas and points of view.
questioning:	posing open-ended questions; examination of problems with no answers; exchange of teacher and student roles; general spirit of inquiry.
modelling:	exposure to good thinking strategies; involvement in group thinking; sharing the thoughts of great thinkers.
self-direction:	student input into learning experiences; making choices and decisions.

These conditions are essential building blocks in the provision of an environment that facilitates and encourages thinking.

Role of the Teacher

As interpreters of the curriculum, teachers play a key role in the success of any program. It is natural, therefore, to begin with the teacher if a program of thinking skills development is to be implemented. Teaching thinking involves blending the critical and creative processes and linking these to real life.

As students progress through the various grade levels of the curriculum, teachers need to plan activities in which students can learn a variety of thinking skills and develop awareness of their own thinking process.

The following are some of the ways teachers can foster thinking skill development.

Modelling Thinking

One way students learn is by imitating their parents, teachers and peers. Teachers can provide examples of the thinking skills they are trying to develop by modelling them. Ways teachers can do this include:

listening:	to students and showing acceptance of their thinking. In this way students learn to accept the thinking of others.
talking:	through problem solving with students. This shows how perseverance is needed when errors and false starts occur.
sharing:	how goals can be set, problems defined or actions taken. As teachers share thinking strategies such as brainstorming, students can see other ways to think about a problem.
discussing:	how to proceed on a problem, what to do with a lack of information. This teaches students how to access information and the use of different strategies in thinking.
demonstrating:	graphic organizers and other techniques used to organize and remember information. Students appreciate the value of mental organizers, such as mnemonics (see Chapter IV of this document) for dealing with information.

By modelling their own thinking skills and techniques, teachers can help students develop these abilities.

Teachers use various thinking strategies in their daily lives. Modelling is simply demonstrating and explicitly sharing these strategies with students. Appendix H presents a framework teachers can use to plan for modelling thinking skills.

Asking Questions

The power of questioning was demonstrated by Socrates many years ago. His example is a reminder that the use of questions by teachers can provoke students to think beyond recalling memorized information. For example, a teacher could use the following types of questions to stimulate students' thinking:

quantity questions:	How many ways might mathematical measurements be used in a day?
forecasting questions:	What could happen if large quantities of gold were discovered in Alberta?
point-of-view questions:	How would a spaceship launch look to a bird? To Leonardo da Vinci? What would an atom look like if you shrunk it to the size of a proton and sat on the nucleus?

As questions become more open-ended they invite greater thinking. As part of their training, many teachers were taught a hierarchy of education objectives developed by Benjamin Bloom. This taxonomy serves as a useful guide to developing questions that encourage students' thinking. Bloom's taxonomy can be depicted as an upwardly expanding spiral that begins with simple recall questions and moves toward questions that probe students' understanding and require complex thinking skills (see Figure 1). As teachers move their level of questions up the spiral, students' thinking will become more complex as they process a question and attempt a response. Bloom's categories are described with sample questions:

Knowledge:	Identification of information: Describe . . . . List . . . . Who, What, Where, When . . . . Recall everything you associate with . . . .
Comprehension:	Organization and selection of ideas: Explain . . . in your own words. Summarize the main idea of . . . . Define . . . .
Application:	Use of facts, ideas and principles: Demonstrate the use of . . . . Interview . . . about . . . . How is . . . an example of . . . ? How is . . . related to . . . ?
Analysis:	Breaking information into component parts: Examine . . . for similarities and differences. Classify . . . according to . . . . Differentiate . . . from . . . . Outline/Diagram/Web . . . . What assumptions are necessary for . . . to be true? What distinguishes . . . from . . . ?
Synthesis:	Restructuring information to create new ideas and concepts: Create/design . . . to do. Use the technique of . . . to . . .? What would happen if you combined . . . ? Devise a solution for . . . . Develop a plan to . . . . Develop a theory to account for . . . and . . . ? If . . . is true then . . . might be true. Modify . . . to . . . . Extend ideas on . . . to . . . .

Evaluation:	Formulating judgments, opinions or decisions based on criteria or standards: How do you feel about . . . as opposed to . . .? . . . is right because . . . . The . . . evidence supports . . . . Do you agree with . . .? Prioritize . . . according to . . . . What criteria would you use to assess . . . ? I recommend . . . because . . . . What is the most important . . .? Is . . . consistent with . . . ? Justify . . . .

Not only is it important which level of questions teachers ask, but how these questions are asked. For example, pausing before allowing the students to respond gives them opportunity to reflect on and think through their response(s). Students of all ages can function in each of the six categories, but this must be done within the context of their knowledge, experience and development level. It is essential to organize learning experiences around the concepts of higher-order questions as they help to extend student thinking.

Bloom's taxonomy can be used to design a variety of questions that stimulate students' thinking.

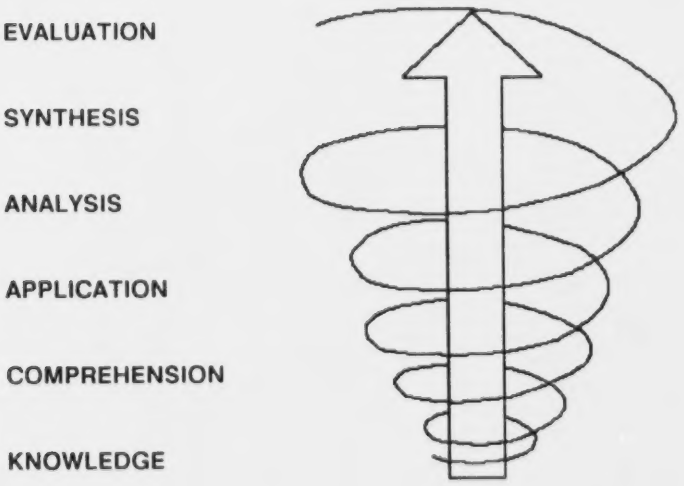


Figure 1

Responding to Students' Answers

The teacher's reaction to students' responses is crucial to establishing a climate in which thinking is valued and encouraged. If the teacher uses criticism, sarcasm or other negative responses, students are less likely to take the risks associated with developing thinking skills. A positive response encourages students, makes them feel accepted and challenges them to think further. Some of the ways teachers can demonstrate their acceptance of various students' responses are by:

acknowledging:	the response without a value judgment, for example, "I understand what you said. . . ." or "That's an interesting possibility . . . ."
paraphrasing:	what the student has said by rewording, extending or attempting to clarify the student's response. Some examples are: "What do you mean when you say these two ideas are connected? Bill's idea is that we group animals according to what they eat. How does this compare to Kim's idea?"
providing information:	to the student. Usually this is in the form of direct positive reinforcement, such as "Good thinking! Other ideas? Yes, you're on the right track . . . ." "There's a book in the library you might want to read." "That reminds me of . . . ."

By asking probing and challenging questions followed by acceptance and extension of student responses, teachers can help the classroom become a supportive and exciting thinking environment.

Roles of the Teacher

Besides modelling thinking skills and using questions to stimulate students' thinking, teachers can select specific teaching strategies that help to define their roles on a continuum in which the student's autonomy increases as the role of the teacher changes (see Figure 2).

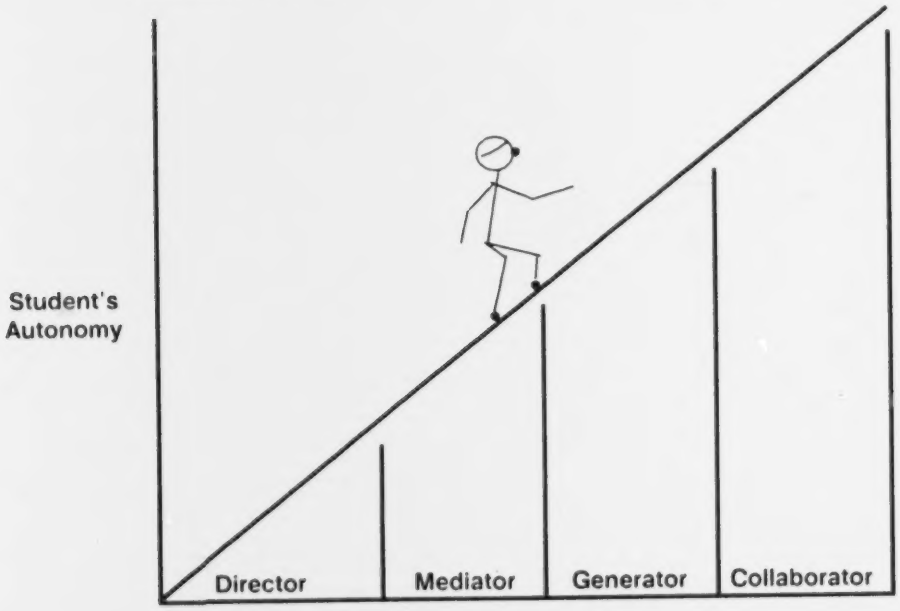


Figure 2

Teaching strategies are patterns of instruction that can achieve thinking and learning expectations when employed over time. The strategies can be grouped into four distinct categories (Costa 1985): directive, mediative, generative and collaborative. Each determines a role for the teacher that includes the use of modelling and questioning techniques.

Teacher as Director

In this strategy the teacher sets the goals, explains the rules or procedures and demonstrates the skill and conditions for student success, such as how to light a Bunsen burner, spell a word or learn a mnemonic. Students learn mainly by imitating skills and methods. Much of the thinking occurs at the knowledge or recall level. Directive strategies are often used to teach basic skills. If the teacher's aim is to have students retain important facts, ideas and skills, this strategy may be useful. Steps in directive teaching include:

1. Introduce the skill
2. Explain the skill
3. Demonstrate the skill
4. Students apply the skill
5. Reflect on the skill
6. Teacher judges skill standard.

Teacher as Mediator

The teacher sets the goal for the class and then assumes the role of guide as students determine the means and methods of reaching that goal. In this way, students begin to be aware of and to regulate their thinking as they see connections, find patterns and discover rules and procedures for attaining a goal. Teachers play a supportive role by raising questions or dilemmas, allowing students to form their own generalizations and develop problem-solving abilities. One example of teachers in the role of mediator is the strategy "find the concept." The goal of this exercise is to give students the opportunity to discover concepts. The example in Figure 3 shows how the concept of "mammals" might be mediated.

	Yes	No
PHASE I: INTRODUCE THE CONCEPT • Teacher presents animals that are, and animals that are not, examples of the concept.	Cow Beaver Giraffe	Shark Mosquito Robin
PHASE II: TEST THE CONCEPT • Students identify the common attributes perceived. • Teacher presents additional examples.	Tiger Mouse	Snake Frog
• Students give further examples and begin to define the concept.	Dog Deer	Fly Dinosaur
• Teacher continues examples if necessary, names or confirms concepts and reviews attributes.	Mammal	
PHASE III: ANALYSE THE PROCESS • Students reflect and describe thinking. • Students discuss reasons for testing concept attained and its attributes. • Students discuss various concepts formed and reasons for the grouping of ideas. • Students evaluate strategies used and discuss ways of improving.		

Figure 3

Teacher as Generator

In this strategy the teacher and student set a common goal and investigate ways to handle the information and ideas needed to attain the goal. The teacher helps the students generate ideas through brainstorming, visualizing and patterning skills (see Chapter IV). Students are encouraged to form creative and novel ideas and to stretch their thinking. Generative strategies appear to have some common characteristics:

- Many ideas are necessary for quality ideas. Questioning directs plural ideas,
  e.g., What meaning . . . ?
  What causes . . . ?
  What ways/kinds . . . ?
  More than one solution is generated to solve a problem. Ideas can become stepping stones for other ideas even if they initially seem impractical.

- Breaking out of patterns and rules is necessary if new ideas are to be generated. This expanding of ideas by manipulating them might include enlarging, eliminating, reversing, combining, adapting, minimizing or substituting ideas. Extend rules and assumptions of reality by asking "what if" questions.
- Probe the possible, the impractical and even the ridiculous for ideas.
- Use errors and dead ends as stepping stones to new ideas.
- Take a meaning from a common context and place it in a new context. Allow new fields to become idea sources.
- Take advantage of ambiguities to generate new ideas. Humour and paradox are useful sources.
- Play and have fun with ideas. Be willing to take risks.
- Use metaphors and analogies to link and generate new meaning.

Teacher as Collaborator

Collaborative strategies are based on the belief that "None of us is as smart as all of us." In this strategy, learning is structured to occur in groups with goals set by the teacher or the group. The teacher facilitates students' interaction, social skills, individual accountability, positive interdependence and group evaluation, as groups develop a spirit of cooperation.

Some of the ways students can be organized for collaboration are:

- paired thinking activities. Students can help each other on an idea, summarize what they know about a topic, or brainstorm together.
- reading pairs. By reading a story together students can help each other understand the story. Pairs could also involve high school elementary partnerships.
- assignment trios. Working on an assignment together, each member of the trio could have a specific responsibility, e.g., one could be a reader, one a recorder of questions, one present to the class. There are many ways to vary the interactions of members of small groups.
- jigsaw. Each member of a small group of three to six students works on some aspect of a problem. The group then pieces together its information to form a complete presentation or assignment.
- team games tournament. A popular way of reviewing material with students. Teams are formed to ask each other questions on the information learned, or are tested together on basic skills. Prizes are awarded to the fastest and most accurate team.

There are many ways to vary the strategies described above. As directors, mediators, generators and collaborators, teachers can stimulate students to become interdependent and creative thinkers. The chart in Appendix I can be used for strategy planning.

Role of the Student

Students do not come to school as "bank accounts" into which information can be deposited or withdrawn by teachers. Instead, students are active partners in the dynamic process of learning. As members of the school community, students need to be made aware of the important role they play in establishing a climate where thinking can thrive.

Asking Questions

One way students can help foster thinking skill development in themselves and their peers is by embracing a spirit of inquiry. The inquiring student is actively involved in learning by questioning what is known and reflecting on how they know. Teaching students to question can begin by having them focus on a task and ask themselves:

1. What do I already know about this topic?
2. What do I want to learn about it?
3. What more have I learned about it?

Before reading about snakes, students can think about what they already know about snakes, e.g., dangerous, scary, helpful to people. They can then identify what more they want to know, e.g., How do snakes kill other living things? This question can become the goal for further reading and research in which the student can verify if the learning intended was achieved. Other questions can also be raised for further research.

A high school teacher discusses her experiences in developing students' questioning skills.

Exciting things are happening in my Grade 10 English classes. I no longer provide questions for discussions and written assignments. I have armed the students with Bloom's Taxonomy. The students have formed their own questions in groups, individually and as a class. They have answered their best questions, all of their questions or exchanged questions to answer each other's. Right from the first day, they like the new approach. I am excited about the students being able to make their own exam for this unit.

Grade 10 Teacher

Self-Questioning

Through self-questioning students can begin to understand their own thinking processes. Teacher modelling is important to guide the building of the concept. As student awareness of this process increases, they are able to regulate and monitor their own thinking, which in turn leads to an appreciation of the thinking of others. Some of the questions a student might address are:

1. How do I know something is true? What evidence do I have to support an idea? (Precision)
2. How do I locate appropriate information? Can I find a way or place to do my best work? (Decision making)
3. How is meaning made? For example what does (book, activity, field trip, discussion, etc.) this teach me? (Finding meaning)
4. How do I think? How do I approach problems? How do I know when I am finished? (Metacognition)
5. Can I stop interrupting? Since it is not my turn, what do I need? (Behaviour)

One way teachers can help students reflect on their thinking and to question themselves is through the use of the "notepad" approach (see Figure 4). By reflecting on what they have learned about their thinking students become engaged not only in the dynamics of learning but in the development of a climate where thinking is stimulated

NOTEPAD

"Questions I Have"	
Task	**Questions**
I have learned:_____	
For next time:_____	

Figure 4

Role of Administration

Teachers and students represent two sides of a triangle of commitment needed if thinking skills are to flourish in a school; the triangle is completed by considering the role of administration. All administrative personnel can demonstrate their commitment to thinking skill development by modelling the type of thinking skills they expect from teachers and students. Also, administrators can help develop a total school commitment to thinking skills if they:

- **Develop an understanding of the demands of teaching thinking**

- **Build ownership, commitment and climate for the success of extending thinking**
  - Build a process of collaborative planning and decision making.
  - Assist staff in working out guidelines necessary to set direction.
  - Articulate programming to the community.

- **Support depth in the curriculum**
  - Encourage interpretation, and in-depth manipulation of information.
  - Extend modes of evaluation to include evaluating in-depth thinking.
  - Support connections between courses of study.

- **Facilitate professional development and teacher thinking**
  - Enable staff to become knowledgeable about teaching thinking skills and strategies.
  - Enable staff to experiment with mediative, generative and collaborative teaching strategies to facilitate thinking.
  - Allow teachers to observe and coach each other.
  - Promote cooperative building and evaluating of programming.

- **Work toward an organization that facilitates thinking**
  - Modify groupings and scheduling to include in-depth thinking, interdisciplinary learning and real-life experiences.
  - Maintain flexibility in accommodating changes and learning outside the school.

- **Promote a total school culture of thoughtfulness**
  - Consider all members of the team as THINKERS.
  - Promote examination of school and classroom issues by staff and students.
  - Reward staff and students for showing creative and critical thinking in their tasks.
  - Provide incentives for staff members taking leadership roles.
  - Build a teacher evaluation system that honours thinking.
  - Encourage critical selection of resources and development of learning experiences.

Emphasis on enhancing students' thinking can be reinforced by the procedures management uses to determine direction. Including teachers in problem solving and decision making acknowledges their

thinking abilities and builds a partnership necessary for effective long-term programming.

- Chapter III explores a process for building successful thinking programming and provides the context that teachers, students and administrators will be operating and learning in.

CHAPTER III

PROGRAMMING FOR THINKING

This chapter outlines a process designed to assist teachers and school communities to grow in their thinking and to consider and resolve the issues important to enhancing thinking in student programming. This growth may involve changes in materials or their use, methods and understanding as progress occurs.

Expectations

A total school environment that values and honours thinking empowers not only students, but teachers, administrators, custodians, teacher aides and parents. Art Costa describes "A school that is the home for the mind" as a place where everyone's intellect is developed. Teachers, who are key players in facilitating thinking and learning, often perform their most creative work in very isolated situations where there is little time to reflect on and share processes and successes. The teacher's thinking drives instruction. Its development not only encompasses an inner processing of ideas but flourishes in interpersonal settings. Teaching must move beyond isolation to a process where thinking, researching and planning occurs in a collaborative setting, where classrooms are open for viewing and where instruction strategies are reflected on. The teaching tasks should include working with students and other teachers in a team approach that empowers all participants and improves the delivery of education.

Expectations for building successful thinking programming include:

- Creating a total environment that values and supports student, teacher and parent thinking.
- Developing a clear understanding of the teaching of thinking among all stakeholders.
- Defining programming dimensions and specific procedures for implementing and evaluating teaching for thinking.
- Teaching skills and processes for enhancing thinking throughout the curriculum in a variety of subjects across grade levels.
- Teaching specific thinking skills and processes in an explicit manner.
- Teaching thinking within a metacognitive context.
- Employing instruction strategies that enhance student and teacher thinking.
- Providing opportunities for transfer of strategies to related areas and real-life experiences.

In the absence of an adequate programming model, the recommended process allows planners to structure thinking programming. The approach guides planners through four stages of development to shape decisions suited to their organization. The process is applicable at all levels of schooling and within a wide variety of administrative models. A teacher planning programming individually can shape decisions through a similar process.

The recommended planning process interprets the thinking activity of the discoverer, creator, evaluator and performer (discussed in Chapter I) as:

1. Exploring the teaching of thinking
2. Creating a feasible approach to teaching thinking
3. Formulating decisions regarding teaching thinking
4. Implementing the approach to teaching thinking.

The activities are described as four stages in Table 3; some specific components for each stage are outlined. Although depicted in a linear fashion, the stages overlap and recur in the actual development process as planners refine and modify programming direction. The factors to be considered in each of the stages are discussed following Table 3.

Table 3

STAGES IN BUILDING SUCCESSFUL PROGRAMMING

STAGE I: EXPLORING THE TEACHING OF THINKING

- examine beliefs, past experiences, present conditions of teaching thinking
- review relevant provincial resources and direction for teaching thinking
- explore resources to build background information, knowledge and understanding of the teaching of thinking
- build commitment to future planning and programming
- explore possible approaches to thinking programming
- analyse and experiment with teaching strategies,skills and processes to enhance student thinking; explore materials and resources
- analyse needs and characteristics of students and/or school community and curriculum

STAGE II: DEVISING AN APPROACH TO TEACHING THINKING

- formulate a plan to initiate action individually or in a group based on needs assessment
- define tasks to be completed and establish timelines
- develop a belief and goal statement
- describe a skilful thinker; i.e., define skilful thinking
- delineate roles of major stakeholders
- plan teaching strategies and skills to enhance thinking
- communicate the plan to major stakeholders
- develop a plan to evaluate direction

STAGE III: MAKING DECISIONS ABOUT TEACHING THINKING

- assess the nature of content and curriculum expectations
- assess range of learner needs
- evaluate skills, strategies and methods to be used
- align learner characteristics, curriculum expectations and thinking skills
- determine avenues for integration and transfer
- evaluate drawbacks, programming direction and modify as required
- evaluate all aspects of planning, biases and assumptions
- identify problems that might arise and means of resolving them

STAGE IV: IMPLEMENTING THE APPROACH TO TEACHING THINKING

- implement long- and short-term plans to reach expectations
- sequence skills across grade levels
- maximize resources and time
- overcome obstacles and problems
- balance strategies used to meet students' needs and learning expectations
- provide a range of instructional strategies and activities
- monitor and evaluate students' progress
- monitor and evaluate overall programming; refine and modify
- maintain a dynamic thinking and learning environment

Stage I: Exploring the Teaching of Thinking

This stage of teaching thinking is one of information gathering, assessing present conditions, building understanding and commitment, and experimenting with skills, strategies and modes of operation. This process could take an individual or school community some time, depending on available resources. It involves assessing the existing programs to determine what is currently emphasized, and to provide a starting point for planning and development. The teaching thinking inventory is one method of initial assessment (see Appendix J). It can be used in whole or in part, and is intended to illustrate the importance of the major stakeholders in building strong programs. Teachers developing programs in isolation can refer to items 11 to 30 of the inventory. Considerations should be prioritized. Here is one teacher's point of view after assessing a total school's needs using the "Teaching Thinking Inventory":

> ***In our school it is necessary to:***
> - ***rekindle thinking as a school priority***
> - ***model open-mindedness among ourselves***
> - ***plan professional development on thinking with long-term follow-up***
> - ***restructure content to allow for the integration of thinking skills.***
>
> **Teacher, Grades 4–6**

This teacher, who has a broad understanding of teaching thinking, identifies her priorities as providing more stimulating materials and learning experiences, sharing successes with others and using a wider variety of instruction strategies. This type of individual and group introspection can further personal and school growth in teaching thinking.

During periods of assessing needs, planners will require an understanding of teaching thinking. Building a strong background is essential to formulating sound decisions and accommodating future concerns. Some valuable sources of general information on the topic are:

A. Audio-Visual Materials

- *A Whack, A Kick and a Poke: How To Be More Creative* – Kit of six audiocassettes, by Roger Van Oech. Available from Nightingale–Conant Corporation, 7300 North Lehigh Avenue, Chicago, Illinois, 60648.
- *Improving the Quality of Student Thinking* – Video available from Association for Supervision and Curriculum Development, 125 North West Street, Alexandria, Virginia, 22314-2798.
- *Teaching Reading as Thinking* – Video available from Association for Supervision and Curriculum Development, 125 North West Street, Alexandria, Virginia, 22314–2798.
- *Teaching Skillful Thinking* – Kit of four videos, User's Guide and book entitled *Developing Minds* by Art Costa. Available from Association for Supervision and Curriculum Development, 125 North West Street, Alexandria, Virginia, 22314-2798.

- *Teaching Strategies* – Kit of four videos and guide, available from Association for Supervision and Curriculum Development, 125 North West Street, Alexandria, Virginia, 22314-2798.
- *Teaching Thinking in Elementary Schools* – Kit of five audiocassettes, available from Association for Supervision and Curriculum Development, 125 North West Street, Alexandria, Virginia, 22314–2798.
- *Thinkabout* – Video series and teacher's guides available from ACCESS Network, Media Resource Centre, 295 Midpark Way S.E., Calgary, Alberta, T2X 2A8.

B. Publications

- *Developing A Thinking Skills Program*, Barry K. Beyer, Allyn and Bacon, Inc., 1988.
- *Developing Minds, A Resource Book for Teaching Thinking*, Art Costa, Association for Supervision and Curriculum Development, Alexandria, Virginia, 1985.
- *Dimensions of Thinking*, R.J. Marzano, et al., Association for Supervision and Curriculum Development, Alexandria, Virginia, 1985.
- *Intelligence Applied, Understanding and Increasing your Intellectual Skills*, Robert J. Sternberg, Harcourt Brace Jovanovich, Orlando, Florida, 1986.
- *Kick in the Seat of the Pants*, Roger Van Oech, Harper and Row Publishers, New York, N.Y., 1986.
- *Techniques for Teaching Thinking*, Art Costa and K. Lowery, Midwest Publications, 1989.
- *Thinking Skills Throughout the Curriculum: A Conceptual Design*, Barbara Z. Presien, Phi Lambda Theta, Inc., Bloomington, Indiana, 47401.
- *Whack on the Side of the Head*, Roger Van Oech, Warner Books, New York, N.Y., 1986.

C. Conferences/Workshops

Participating in ATA Specialist Council workshops, annual conventions and professional development days where specialists explore the area of thinking/learning, is essential to building an understanding of the area. Resource exploration plays an important role in building understanding and commitment. Planners are encouraged to explore many avenues of information including colleagues interested and experienced in teaching thinking. Organizing a central collection of general references and specific strategy resources can help build teachers' background knowledge. Some additional resources are listed in the references section of this document.

Stage II: Devising an Approach to Teaching Thinking

Once information has been gathered, decisions need to be made either individually or as a group, school or school community. The needs of the students and teacher must take precedence in decision making. The support of other staff and parents plays an important role in the overall success of programming.

Appointing a planning committee is an expedient way to combine efforts and provide leadership. Members of a planning committee might include a school administrator, teachers with special interest and

expertise, a student representative and parent/community representatives. The size and composition of the planning committee will be determined by the individual or school community, and resources available. Based on an analysis of the Teaching Thinking Inventory, the committee can begin to formulate plans and tasks to be completed. Where planners find themselves formulating decisions individually, they can elicit input from school administrators, other teachers, students and parents.

Devising an approach to teaching thinking will involve initiating action on the following questions:

- What is my (our) belief statement about teaching thinking?
- What are the expectations for student thinking and development? How will they be assessed and evaluated?
- What are the roles of the major stakeholders—teacher, parent, student and other staff participants?
- What teaching methodologies and strategies will be used to enhance student thinking?
- What learning experiences will be implemented and what resources will be used?
- How will the plan be communicated to stakeholders?
- How will effectiveness of programming be evaluated?

A short write-up of the belief statement and expectations for student thinking and development can guide all further decision making and ongoing teaching decisions. Time to synthesize viewpoints is essential to programming success.

Table 4 provides an exploration of possible student, teacher, parent and administrator roles. The scope of programming may include others, such as senior administrators or curriculum developers. Regardless of the scope of programming, it is recommended the stakeholders go through a process of delineating their own roles and coming to an overall consensus of responsibilities. Roles can be extended and modified as required.

Table 4

CHANGING ROLES

STUDENT

- Participate in decisions related to learning.
- Set goals and expectations for own thinking and learning.
- Contribute to the harmony of the group and its efforts.
- Assess and monitor self, efforts and products on an ongoing basis.
- Identify, share and extend personal strengths, interests and style.
- Accept and cope with limitations of self and others.
- Participate in an ongoing evaluation of own progress.
- Share learning and thinking successes with others.

TEACHER

- Assess and evaluate student characteristics and needs and create matched learning experiences to enhance that thinking.
- Set expectations for self and students' thinking.
- Guide rather than direct learners through thinking/learning.
- Allow students to make decisions in the course of thinking and learning.
- Teach explicit thinking skills and strategies.
- Design opportunities for transfer of skills and strategies into other disciplines and real-life experiences.
- Listen and extend student ideas, questions and progress. Seek clarification.
- Teach skills in a metacognitive context.
- Model effective thinking and decision making.
- Collaborate with others in decision making.

PARENT

- Develop an understanding of thinking.
- Accept the thinking characteristics and abilities of your child.
- Allow the child independence in thought and action with many opportunities for decision making.
- Listen and discuss child's ideas and questions. Seek clarification.
- Encourage and respect child's thinking.
- Encourage coping appropriately with the consequences of their decisions.
- Encourage open communication about concerns, feelings, successes and frustrations.
- Provide honest and constructive feedback to child—understand thinking expectations.
- Encourage child's reflection on change in self and others.
- Work in cooperation with school to meet child's needs.
- Volunteer time and resources to support school programming.

ADMINISTRATOR

- Facilitate the development of a school philosophy to support student and staff thinking.
- Provide leadership in developing awareness of teaching thinking.
- Create an environment where staff and student thinking is respected, rewarded and extended.
- Ensure teachers are knowledgeable about teaching thinking and that appropriate modifications are made.
- Allow flexibility in programming to facilitate unique teacher and student needs.
- Coordinate planning and programming to ensure continuity of teaching thinking.
- Provide personnel and resources to support the teaching of thinking.
- Involve teachers, parents and students in decision making.
- Model effective thinking and decision making.
- Monitor direction and instructional decision making.

Stage III: Making Decisions About Teaching Thinking

Since learners vary so greatly in their experience, cultural background and areas of strength and needs, short- and long-range plans should be personalized to fit the needs of the students, teachers and schools. A process of data gathering can obtain information about student's strengths and weaknesses, learning preferences, developmental levels and curriculum needs. Further evaluation will include:

- assessing thinking skills and teaching strategies of focus
- assessing where skills are already embedded in curriculum or in what areas they might be introduced or extended
- assessing learning resources
- determining means of evaluating and communicating student progress.

A model or process to combine all stakeholders' decisions in curriculum and instruction planning will begin to take shape. There is no given model, taxonomy or process that will suit all learners or teachers across the province. Many commercial programs are available and many tend to be stand-alone thinking courses. Certainly, aspects of some may be integrated into programming to assist in meeting expectations. It is the position of Alberta Education that thinking skills should be taught within the contexts of school subjects and the students' lives. No one model exists to suit all learners and all content areas. Planners finding a direction for their students must tailor-make a model, building from:

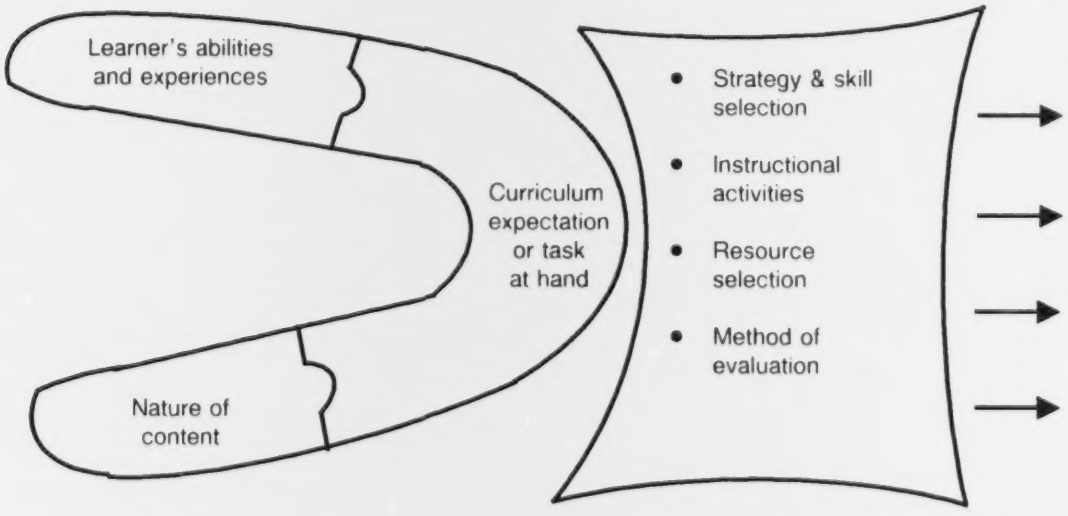


Figure 5

A selected program or resource should:

- define, develop and practise a particular thinking skill or skills
- be developmentally appropriate
- explore specifics of skills as well as metacognitive or self-management strategies
- be motivational as well as responsive to the intellectual needs of the students
- be easily integrated into any subject area
- be adaptable to individual differences
- provide opportunities for transfer of strategies
- provide suggestions for evaluating students' progress.

Stage IV: Implementing the Approach to Teaching Thinking

Implementing thinking programming is no small task. The challenge of carrying plans into action requires perseverance. It is essential to maintain a focus on expectations, take risks, learn new skills and strategies, build on mistakes and maintain partnerships for support.

Implementation must occur at two levels. One is the classroom level where skills and strategies are introduced in different subjects at specific times during the year. Implementation must occur across grade levels and subjects so that skills can be built on and expanded. Bridging experiences across levels involves making decisions related to the level at which skills can be introduced, extended and refined. Increasing complexity and building opportunities for more divergent transfer are essential to growth and independence.

Balancing the types of teaching strategies must also occur. As recommended in the section on teaching strategies in Chapter II, a greater inclusion of mediative, generative and collaborative strategies is necessary to enhance students' thinking. Directive strategies may be required initially for some students and for certain skill teaching. The other strategies are essential to promote growth in students' thinking. Teachers may require training and coaching in strategies new to them and opportunities to view others' successes. It is necessary to provide a range of instruction strategies and activities that accommodates the visual, kinesthetic, oral and written modes of learning.

Following are examples of strategies and activities that can involve the whole school community in implementing the thinking program:

- collect and interpret quotations
- "find new uses for old things" centre
- pose a problem of the day or week
- set up interactive bulletin boards
- keep a diary, log or journal of experiences
- interpret political cartoons
- design own report card
- compose a headline for a problem or unit of study
- have students design a learning centre or bulletin board
- take a position on a current issue
- combine subject areas in a broad theme
- schedule student presentations and seminars
- schedule peer tutoring
- solve a school problem

- allow option of contract learning
- test a theory
- create thinking licence plates
- keep a "new inventions" chart and add suggestions to improve old products
- play devil's advocate in a group discussion
- organize group research projects
- locate a community resource or mentor
- role play differing points of view.

Whether you think you can or can't you're right.

Henry Ford

The process of exploring, synthesizing, evaluating and implementing the teaching of thinking must be flexible. The teacher or school community is constantly shifting from one stage to another to refine their direction and path of success. Rerouting programming direction according to student characteristics, successes and failures is critical. Further exploration, experimenting and evaluating may be required by teacher or teachers to reach their desired goals and ever-changing student needs. Thinking performers are the discoverers, creators and evaluators working together to overcome obstacles and excuses. They blend and align all the variables of the teaching and learning process to make a thinking school community.

CHAPTER IV:

THINKING SKILL DEVELOPMENT: SUGGESTED CLASSROOM ACTIVITIES

This chapter looks at metacognition, sample thinking skills and subject integration.

Metacognition

Metacognition is thinking about your thinking. It is crucial to the development of all thought processes. Individuals, in furthering their thinking, must be conscious of their thinking processes and engage in discussion about what's going on in their heads during thinking. Figure 6 depicts the variables involved in metacognition.

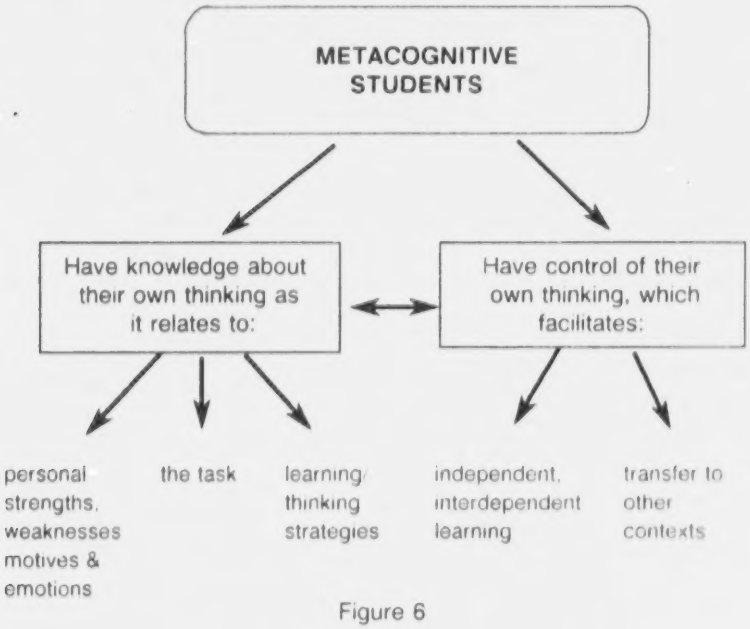

METACOGNITIVE STUDENTS
Have knowledge about their own thinking as it relates to:
Have control of their own thinking, which facilitates:
personal strengths, weaknesses motives & emotions
the task
learning thinking strategies
independent, interdependent learning
transfer to other contexts

Figure 6

Thinking about thinking can include learning about how the brain operates, understanding famous thinkers and engaging in an ongoing dialogue about personal thinking.

Developing Metacognition

There is no one right way to begin teaching students to be aware of their own thinking processes. A good starting place would be to encourage an initial awareness of habits that influence how individuals think. For example, if a group of students were to focus on thinking habits some of the students might discover they are easily distracted when concentrating on a task. This awareness is metacognition. These students have thought about their own thinking and recognized areas where their thinking could be improved.

The Know Myself Inventory (Appendix A) is a metacognition activity that asks learners to reflect on the attention, attitudes and commitment they bring to any task. Through this exercise learners discover more about their thinking process and the role of attention in thinking. After using the Know Myself Inventory, teachers may wish to focus on attention, that is, discuss and explore the role of attention with their students. A sample lesson follows.

Thinking About Attention: Lesson Plan

Learner expectations:

Students should be able to:

- understand that attention is a decision they make
- explain how attention can be focussed
- describe how to make a topic interesting to themselves.

Materials:

Each student should have:

- a sheet of paper with a small drawing of a triangle on it
- colour felt pens.

Teacher should have:

- a stopwatch or watch with a second hand.

Activity:

Students are asked to focus their attention on the triangle on their sheets for two minutes. During this time the students should think about what they do to keep their attention on the triangle. At the end of the two-minute exercise each student should write how they manage to keep attention. From these notes a class list of strategies for focussing attention can be generated. This list could expand as new methods are discovered.

Variations:

1. Students could be taught how to "bracket" their attention: ignoring other stimuli as they focus on a particular task. See Appendices B and C, which could be useful for this variation.
2. An "attention graph" could be made, where students chart their attention level during various activities—walking home, eating lunch, etc. See Figure 7.

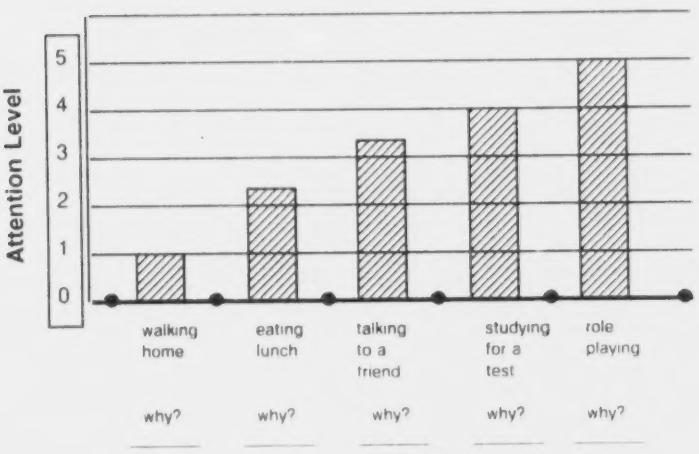


Figure 7

3. Students could keep an "attention journal" that records how attention varies during the day or that charts attention over a week during a specific class or activity.

The ability to focus attention is one thinking skill that fosters metacognition. Another variable involved in metacognition is knowing what we know and what we do not know about a task. Before investigating a topic, students can first relate their factual knowledge in an area by brainstorming, listing, following one of the formats in Figure 8 or by generating their own method of expressing what they know and do not know about a topic.

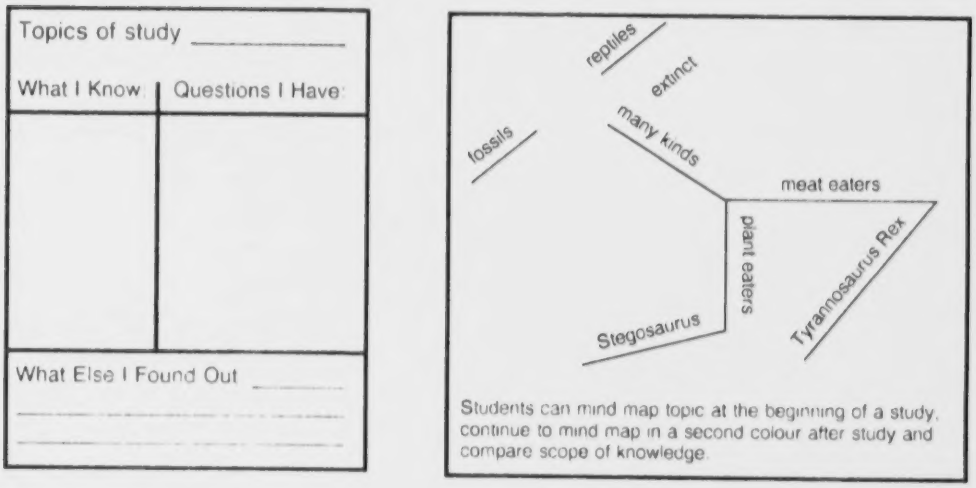

Topics of study _____
What I Know
Questions I Have
What Else I Found Out _____
reptiles
extinct
fossils
many kinds
meat eaters
plant eaters
Tyrannosaurus Rex
Stegosaurus
Students can mind map topic at the beginning of a study, continue to mind map in a second colour after study and compare scope of knowledge.

Figure 8

Factual knowledge can include knowing that one reads a play differently than a novel. Knowing that characters' names, emotional expression and stage direction are part of the text can influence modes of reading and overall comprehension. Knowledge about how to perform a strategy, how to mind map, how to chart, how to summarize or how to brainstorm also includes the information necessary to carry out these strategies. Information or strategies can then be chosen according to the goal at hand. Another variable involved in metacognition is knowing which strategy might enhance or detract from performing a task. Knowing when to mind map rather than summarize involves knowing why a given strategy can produce certain results.

Metacognition is the essence of thinking, learning and doing. It is the performer spirit in action. Through persistence, the learner recognizes discrepancies, alters strategies and moves around obstacles to achieve goals. Strategies of thinking must be taught within this context and embedded throughout subject area teaching. Sample strategies to enhance metacognition include:

- **Skill Planning**: Before incorporating a skill, students will need time to discuss attributes, steps, rules of use or variations. Successes with the skill and a present purpose can be

highlighted. During application of the skill, process and perceptions can be discussed. After the activity, students can be guided to evaluate their processes, changes made and overall success discussed.

- **Predicting Content:** Before a reading or unit of study, students can generate questions to predict the content of a unit of study. What questions will the author or unit of study answer? This can facilitate further self-questioning and self-checking behaviours, and overall comprehension.
- **Being Conscious of Constant Decision Making:** Students can talk through a point of decision, reflect on the criteria used, explore the consequences and weigh the evidence that leads to a decision or behaviour. If they are not perceiving cause-and-effect relationships, this process can heighten the teacher's awareness of this and the need for mediation. It can direct the student to further information gathering. It can make students aware of behaviour decisions they make and reasons for them.
- **Establishing Internal Standards:** Students can be asked to identify particulars of things they have done well. They can invite feedback from peers, parents and teachers, and integrate this information into their own standards. They can generate a "pat my own back" list in journals or diaries. These can be reflected on after completing a task. Standards can be compared with others and raised as necessary. Students can be made conscious of evaluating a standard to see if it is truly their own or one borrowed from a peer with little critical thought.
- **Differentiating Between I Can't and I Won't Behaviours:** Attitudes such as I can't, I'm bored or this is too difficult are unacceptable classroom behaviours and should become unacceptable personal behaviours. Ownership has to move to the learner to determine the difficulty, the problem or state of dissatisfaction and determine a plan to move forward. "I am having difficulty and I need to know _____and _____ and _____to complete this task," or "This activity would be more exciting if I could also do _____ and _____," are more acceptable responses. Teachers and parents can be too quick to take responsibility for student difficulty and lack of interest, making students dependent on them for planning and monitoring tasks.
- **Developing a Thinking Language** can include labelling students' and the teacher's thinking skills and processes, e.g., "You used describing words and a lot of action as criteria in evaluating your writing." This reflection of students' ideas invites good listening, paraphrasing and precision in language, e.g., "What I hear your steps in the sequence to be are . . . ." Students can be encouraged to develop a thinking language to describe their own process. Concepts like brainstorming, flow of ideas, planning and assessing can become an ongoing part of their vocabulary.
- **Evaluating Great Thinkers:** An exploration of the interpretation, perceptions, decisions and behaviours of powerful thinkers like DaVinci, Einstein, Mozart or successful present-day thinkers can expand students' standards and viewpoints of thinking. Having a prominent community, school or class member discuss their thinking process can extend awareness and further "thinking about

thinking." Understanding how others set goals, recover from error, deal with lack of knowledge, obtain feedback and make decisions can influence thinking style and changes in processing. Students can begin to feel more secure in disclosing thinking strengths and weaknesses. Good thinking models are important to overall growth.

Activities such as role playing and journal writing provide further opportunities for examining your own thinking and the thinking of others.

Thinking about thinking builds insights into the nature of your own processing and builds an awareness that monitoring efforts can achieve success. With increased independence and control of learning come increased feelings of competence and self-worth.

Greg, a Grade 4 student, represents his metacognitive processes as five questions to always ask oneself. They are:

W.A.I.G.T.D.A.T.	–	***What am I going to do about this?***
W.C.I.L.F.T.	–	***What can I learn from this?***
H.D.I.F.	–	***How does it fit?***
W.D.I.F.	–	***Where does it fit?***
W.D.I.F.	–	***Why does it fit?***

Sample Thinking Skills

Learning and thinking include processes for relating what is already known to new information. In learning to drive a car, a person acquires the ability to shift gears, signal, apply the brakes, accelerate, steer and so on. Initially these skills might be practised in isolation but eventually become part of a larger process of turning a corner, parking or passing. Similarly, thinking can be viewed as component parts that, in combination with skills, facilitate the processes of problem solving, decision making, comprehending, researching, communicating and interacting with others. Different processes in different contexts require different combinations of skills. To comprehend, we analyse, check for accuracy, identify attributes and relationships. In problem solving we define the situation, set goals, gather information, formulate and evaluate alternatives. Breaking processes down into skills can be useful for designing units of instruction and guiding practice with the ongoing understanding that skills rarely occur in isolation.

As teachers begin the arduous task of meeting programming expectations a process of selecting skills of focus must occur. Some of the skills and processes that will assist learners in becoming successful discoverers, creators, evaluators and performers are described in the following chart. The chart is not inclusive but begins to suggest a range of skills involved in enhancing thinking. The decision as to which skill to focus on will be based on students' characteristics, needs and programming direction. The roles may also occur simultaneously as context demands shift and change. It is incumbent on the planners to select or generate the skills and strategies necessary for their learners to become independent thinkers. Appendices C-1, C-2 and C-3 provide student assessment forms that may assist planners in skill selection and generation.

Sample Thinking Skills*

Discoverer	Creator	Evaluator	Performer
• sensing	• visualizing	• evaluating	• integrating
• questioning	• generalizing		• transferring
• brainstorming	• synthesizing	• verifying	
• categorizing	• patterning		• decision making
• focussing	• organizing		• goal setting
• analysing	• inferring		• forecasting
• remembering	• generating	• elaborating	• restructuring
• planning		• monitoring	• regulating
• risking	• feeling	• valuing	• persevering

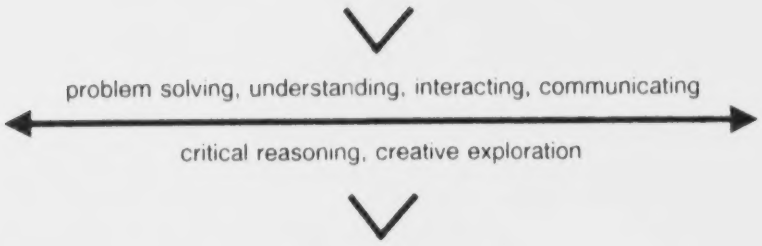

problem solving, understanding, interacting, communicating
critical reasoning, creative exploration
THINKING & LEARNING

Figure 9

* Readers are also referred to Skills of Intelligence, Appendix K

Sample skills will be further developed as classroom, subject area examples. A process of directly teaching the skill is discussed along with methods of integrating it into subject areas and real-life situations. Several skills have been selected and further elaborated as examples of possible development. They are:

- brainstorming
- visualizing
- remembering
- goal setting
- categorizing
- patterning
- synthesizing
- elaborating
- evaluating
- decision making
- forecasting
- planning
- communicating
- problem solving

These 13 have been chosen as they are very generic in nature and subsume aspects of other skills. Problem solving and issue resolution are larger processes that integrate combinations of skills. Teachers are encouraged to view these as beginning examples, and to pursue development of skills in direct response to learners, content and expectations of study. Selecting and generating other skills may be required.

Brainstorming

Definition: Brainstorming is the ability to generate a wide variety of ideas on a topic or theme.

The probability is that 999 of our ideas will come to nothing but the thousandth one may be the one that will change the world.

Alfred North Whitehead

Skill Attributes: Attributes involve producing a flow and large quantity of ideas, withholding judgment and reaching for quantity through limited conversation and explanation of the idea. Hitchhiking of ideas can occur. The value of a large number of ideas in the creative process can be discussed.

Direct Teaching: Initial group brainstorming can model its attributes. A recorder can take down all ideas with other learners taking responsibility to record ideas missed. Students can generate their own list, share ideas and continue to further generate ideas. Processes used to attain new ideas, and break mind sets can be evaluated. Students can set quantity target numbers, e.g., 10 to 15 on a list. For students having difficulty, lower target numbers can be assigned. Teachers can emphasize quantity, e.g., "What are the things you think of that relate to_____?", "Come up with ideas for_____", or "List all the_____ things you can." Teachers can move students from verbal fluency to visual and written fluency.

Application:

- List ideas associated with envrionment abuse.
- What are the things you associate with green?
- List all the synonyms for small.
- Discuss all the ways we use numbers in our life.
- In pairs, tell a partner all you know about the Inuit, then have your partner add additional information. Keep reversing until information has been exhausted. Verbal brainstorming or fluency can be used for unit review or focussing in on a new area of study.
- In magazines locate pictures of items that have round shapes. Draw additional round spaces common to your environment.
- What different mathematical operations can you use to depict 10?
- List freedoms given to people in the Canadian Constitution and Bill of Rights.
- Demonstrate all the ways you can move your body across the floor.
- Use reversals to create a greater flow of ideas. e.g., list ways to go on a vacation, then list ways to have a vacation come to you.
- List ways to earn or save money.

Juntune (1984) provides guidelines for the use of brainstorming and the development of fluent ideas.

Visualizing

Definition: Visualizing is the constructing of mental images, sensory impressions, emotions or verbal linkages about a focus of thought.

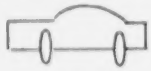
Skill Attributes: Visualizing involves the creating of mental pictures related to information and projecting physical sensations or emotions to an idea, topic or theme. It can include a mental linking or a mental discussion about the information in the form of dialogue, story or action. This ability to link and create meaning is a powerful tool in concept development, comprehension and information retention.

Direct Teaching: This skill involves guided direction in forming, recalling and discussing the formation of mental images, sensory impressions, emotions and verbal linkages. Create a mental picture of information you are trying to process, put the information into words or talk to yourself about the information. Create sensory impressions, symbols or emotions related to an idea. Put into words the sensation and emotion. Visualizing can highlight information just learned, assist in retrieving information and stimulate the restructuring and creation of new ideas.

Application:

- Practise creating images related to a concept. Expand images as new information is gained.
- A teacher may direct the image formation while students, closing their eyes, form their own picture, e.g., a buffalo hunt on the prairies. "The warm sun is beating on your back while you crouch down behind a rock among the bushes. You peer over to view the herd of buffalo and observe another hunter approaching. You move in the crouched position, adjusting the buffalo skin over your body. You test the wind with a damp finger. You adjust your direction." Students can continue the image formation, discuss their images and recreate the image by drawing or role playing. Factual information is more easily remembered in the context of a meaningful story that links historical information with a learner's present experience.
- Imagine a process before setting out to do it. The process and steps of locating information in the library or conducting a science experiment can be visualized. The process of creating detail and predicting what information will be obtained can provide direction for actual activities. Anticipated results can be compared with actual results.
- Form images for sensory impressions and emotions related to story students are about to read. Discuss impressions, predicted relationships and then compare impressions with actual reading.
- Visualize topic or theme before creative writing.
- Visualize gymnastic movements or routines before performing them.
- The sketching of mental images is a powerful thinking tool. Differentiate between drawing (use of much detail) and sketching (using as few lines as possible to create an image). Images first and foremost must be meaningful to the creator as they often retrieve past experience. Sharing in a supportive manner can expand awareness of concept attributes. Examples are illustrated on the following page.

- Sketch concrete and abstract words or concepts using as few lines as possible, e.g.,



car

work

- Sketch the definition of difficult vocabulary words, e.g.,

significant

disturbed

- Sketch five steps you need to do in a science experiment
- Sketch shapes or images of words difficult to spell, e.g.,

hopping

- All images meaningful to the creator should be accepted.
- Sketch a concept using only shapes (see Patterning for further ideas), e.g.,

water cycle

- Sketch a question and have partner sketch the answer.

- Sketch a story sequence that will later be retold.

Sketched images assist in forming linkages and creating meaning for the task at hand. Reflect and discuss the power of images in thinking. Juntune's (1988) video on mind sketching discusses practical techniques for applying this skill. Skills related to visualizing are discussed under patterning with an exploration of graphic organizers.

Remembering

Definition:	Remembering is using sets of cues associated with information so it can be easily recalled.
Skill Attributes:	Attributes of remembering include identifying what information is needed to be remembered, organizing the information into a list and creating meaningful cues to jog memory.
Direct Teaching:	Mulcahy, Marfo, Peat and Andrews (1987), describe numerous mnemonic strategies students can use to

remember pertinent information. The COPS self-correcting skill consists of a set of cues to help students proofread their own writing. The cues represent:
C = words to be Capitalized
O = the Overall organization
P = the accuracy of Punctuation
S = the accuracy of Spelling
A meaningful image of COPS and its relationship to editing can be established. The visualized drawn, verbal or written meaning can be discussed. Students can read a composition to check aspects represented by the letters. The mnemonic can be used in component parts or as a whole while scanning and improving the composition. Effectiveness of the strategy can be discussed along with other ways of using and generating mnemonics.

Application:

- mnemonic strategies can be used in recalling
  - spelling of words
  - procedures in a simple or complex process
  - a lengthy set of pertinent facts or ideas
- EGBDF (Every Good Boy Deserves Fudge) indicates the notes on the lines in musical scale. FACE indicates the notes in the spaces. The meaning attached to the cues assist in retrieving the information.
- UDCL (Ugly Ducklings Cry Louder) can represent the mathematic framework for problem solving.
  U = Understanding the Problem
  D = Developing a Plan
  C = Carrying out the Plan
  L = Looking Back

Students can generate memory strategies for remembering bus schedules or timetables. Marzano and Arrendendo (1986) describe memory frameworks that include the use of a rhyming pegword method and a familiar place framework method. Items to be recalled can be associated with a number and rhyming word, or with a familiar place. In summary, remembering can be facilitated by mnemonics, acronyms, sentences, stories, pegwords, familiar places and key words. The creating of associated mental pictures, emotions, sensations or symbols can aid in information retrieval.

Goal Setting

Definition: Goal setting is determining the direction of a task or an idea and regulating progress in that direction.

Skill Attributes: Goal setting guides task performance. Goals can determine direction for short- or long-term priorities and can be broken down into subcomponents. They can be abstract or concrete in nature. A time factor can assist in regulating completion. Goals

can be changed and altered as required. Goal setting is the initial step in the planning process.

Direct Teaching: Visualize yourself reaching a goal. Specify goal in a written or symbolic form, and identify subgoals if necessary. Specify procedures and steps in reaching goal. See form in Appendices C and D. The more specifically a goal is stated, the more likely it will be accomplished. Differentiate between short- and long-term goals. Begin identifying and planning for short-term goals. Attack a long-term goal by identifying subgoals. Determine timeline of anticipated completion. Differentiate between concrete and abstract goals, e.g. being a hockey hero versus scoring 20 goals and assists in a season. Discuss the changing or altering of a goal. Goals are tools, not rules, and are to be used accordingly. Reflect on the goal- setting process; if it has been achieved, what was effective about the process and how it could be improved.

Application:

- In journal writing, have students identify short- and long-term goals they want to accomplish or have accomplished, determine why the goal was important, what made it difficult or easy to accomplish. Review failures in goal setting and generate a class advice list for others attempting to set and meet goals. Review long-term goals occasionally and alter as required.
- Set academic and non-academic goals at the beginning of the day or period. Reflect on goal attainment at end of period or day.
- Set goals and subgoals for the completion of an independent study project. Monitor own progress.
- Rewrite vague goals with greater specificity, e.g., to be better organized or to timetable important events and deadlines daily.
- Identify teacher goal and learner goal for lesson at hand.
- Set personal goals for a unit of study, a course of study, a year at school or high school years.

Categorizing

Definition: Categorizing is the ability to move from one thought to another and consider information from different perspectives.

Skill Attributes: Categorizing includes becoming aware that an idea can belong to a group of similar concepts. Categories make the mind shift or hop from one set of concepts to another set of concepts. To become a category, ideas require similar attributes. Two or three concepts with similar attributes can form a category. Ideas can belong to more than

one category. Categorizing covers more ideas, more thoroughly and quickly than brainstorming. In generating categories each idea identified must also have a category identified. Teacher talk includes: "List different kinds of, ways to, reasons for, etc. _____."

Direct Teaching: In groups of two to four, have students focus on a topic. Generate an idea and the category label and move to a new idea and category, e.g., things that are hollow:

empty box	– containers
macaroni	– food
tree	– plant
chair leg	– furniture
promise	– human behaviour

Once a category is chosen, students can be directed to generate other categories. Reflect on and evaluate category formation. One category can be expanded to trigger new ideas. Discuss similarities and differences in categories developed, in concrete and abstract categories, and how formation of category comes about. Reflect on processes used. An individual target number of categories can be set as in a brainstorming activity.

Application:

- Capitalization/Punctuation – search through a newspaper or story for examples of capitalization or punctuation. Record the idea and the category.
- Generate categories for structures of stories or novels, e.g., theme, plot, setting and character. Students' own categories may not be as general. Further, language arts content can be analysed in terms of these categories.
- Generate a class list of categories.
- Choose three categories from a master list. Expand ideas under each of the three categories. Use ideas for paragraph, story or poetry writing.
- Identify problems that arise living in a city. Record the problem and the category.
- Identify items in own room to be organized. Record the idea and the category. Explore categories that can be combined.
- Think of different ways to conduct relays in the gymnasium or outdoors using different pieces of equipment. Record categories. Demonstrate best idea.
- Generate categories of information in an area of study. Reflect on the scope of the topic.

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Patterning

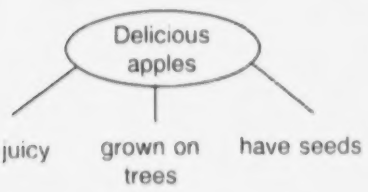
Definition: Patterning is the recognition of associations and linkages in information.

Strategy: This skill involves seeing associations and organizational patterns in information.

Attributes: Information can be restructured externally to depict the internal organizational structure individuals have or develop to sort knowledge. The difference between the general pattern or larger concept and supporting detail can be observed. Patterns can be illustrated or graphically outlined, depicting relationships of information.

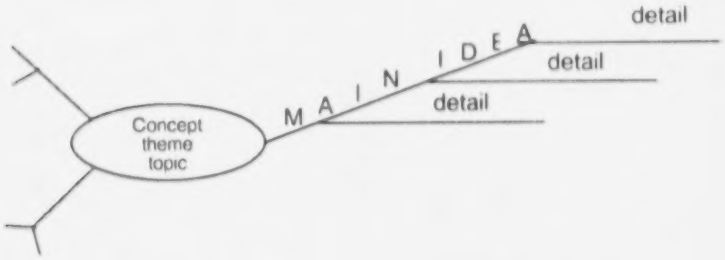
Direct Teaching: Organizational patterns of information can be presented and depicted graphically.
Formats must be practised and appropriate or newly generated graphic formats chosen when meeting new information. Some basic patterns include:

1. **Concept/Theme Patterns** – characteristics of a concept or theme are described.



Apples are fruits.
- They are sweet and juicy.
- They grow on trees.
- They have seeds inside them.

Webbing or mind mapping can depict a basic concept or theme with supporting main ideas and detail.



One word or phrase can be used to represent information. Full sentences can be used when required. This format can be used when there is a larger central theme or concept to be depicted e.g., extinction, a place or geographic region (northern Alberta), a process (mitosis) or an issue (genetic engineering). The central idea, attributes and details can be described with relationships between attributes represented.

2. **Sequence Patterns** include information occurring in related links:
Initiating Event

Depict the neutralization of acid. Specifics of the process can be indicated.

Depict the changes in human shelter from the cave to the highrise

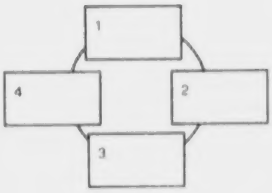
Information such as historical events, information with goals, actions and outcomes, or knowledge occurring in a linear fashion can be depicted in a sequence pattern.

Continuums can describe subtle degrees of change in a sequence of information or events.

low beginning _____ high end

Information containing specific endpoints can be depicted in this manner. Timelines and subtle changes in degrees of development or meaning can be depicted using designated endpoints. This can be a useful format for self-evaluation, peer evaluation or teacher evaluation. Concrete to abstract concepts can be depicted in this manner, e.g., a yellow to blue continuum could depict the many variations in the combinations of the two colours, a student dependency to independency continuum can depict a range of student dependency on teacher direction. The amount of daylight throughout the year can be depicted by placing the months on a continuum of minimum to maximum daylight hours.

Cycle patterns are a particular form of sequence pattern where events never end but continue to recur.



Life cycles, weather phenomena, achievement, behaviour cycles and other self-generating or reinforcing phenomena can be depicted in circular graphics.

3. **Generalization Patterns** involve the organization of information in a fashion where details support the generalization of a broader statement. Inferences are made through the combining of associated ideas.

4. **Compare and Contrast Patterns** involve exploring the similarities and differences between ideas. This type of charting can be useful in recording information during a reading or research process. It can also be used effectively in extending student thinking by asking them to compare something in an area of study to something outside the area of study.

5. **Cause and Effect Patterns** involve identifying the cause and effect relationships ideas have.

   During reading, discussion or research, cause and effect relationships can be identified, generated and recorded. What would be the cause and effects of polar bear becoming extinct, settlers coming to Alberta or not doing your homework?

   Patterning can also include identifying numerical and spatial patterns. Recognizing numerical and spatial relationships and recurring information is necessary to extend learners beyond linguistic patterns, e.g., determine the next number in the series 8 12 16 20 ___.

Application:

- Have students identify patterns in passages of information.
- Discuss advantages and disadvantages of pattern types. Combine patterns or generate new modes of depicting relationships in information. Reflect on ways different patterns illustrate different information.
- Form a pattern for information that has combinations or layers of meaning.
- Isolate elements of a narrative passage into a pattern. Construct your own story based on this pattern. Compare patterns of stories and authors. Explore writing genre.

- Explore patterns in a debate, an essay, newscast, speech, advertisement and their consistencies. Evaluate the use of a patterned form and its effectiveness.
- Explore problem solving as a universal pattern.
- Explore creative patterns of artists' compositions.
- Sketch patterns of mathematical operations.

Synthesizing

Definition: Synthesizing is combining, structuring, generating and often reconceptualizing information into a new form.

Skill Attributes: This skill is essential to concept formation and idea generating. It involves using prior knowledge, adding new information and forming new connections between prior and new knowledge. It can involve inferring, formulating a hypothesis or questions, and inventing something new, or unusual in an area of study. Every learning experience should involve the synthesizing process.

Direct Teaching: Synthesis will involve the generating and shaping of an idea based on one or more examples of the idea. Common examples can be generated first, shared, then students can attempt to retrieve or produce unusual ideas or combinations of ideas. Use of analogies and breaking mindset by substituting, combining, adapting, modify-minify-magnify, eliminating, reversing or reordering ideas can produce new combinations of ideas. Synthesizing can be done at all levels of student development. Students can combine ideas to form new concepts, e.g., new titles to pictures, stories, creative movements, sculptures, etc. Concepts can be combined into new patterns, structures or products. Generalizations can be combined to form new principles and theories.

Application:
- Combine a character from one story with a character from another and create an adventure.
- Formulate scientific or literary hypothesis. Poetry, which is often ambiguous, can leave room for inference and the structuring of an interpreted new form.
- Create unusual ideas.
- Generate a list of unusual places to find water, e.g., on the knee.
- Speculate on unusual uses of levers or friction.
- Design an unusual pollution-free mode of transportation.
- Create a new holiday to celebrate a body organ other than the heart.
- Think of new uses for styrofoam coffee cups.

- Retell a story from a silent character's point of view. Retell *Little Red Riding Hood* from the point of view of the wolf. Replay a hockey game from the point of view of the ice.
- Develop a recipe describing self.
- Create new meanings for idioms and illustrate, e.g., what's the score, hand in there.
- Form metaphors and analogies for common processes or events, e.g., playing baseball is like_____.
- Before reading a selection create questions an author might have answered on the story or topic at hand. Verify predictions.
- Formulate new generalizations or positions on current ideas. Is life in Russia really changing? Do we really want world peace?

Elaborating

Definition: Elaborating is the embellishment or addition of detail to ideas or products to enhance meaning or interest.

Skill Attributes: Elaboration aids comprehension and communication. It involves adding detail, examples, explanations or bridging gaps in information to further progress, and enhance meaning and interest.

Direct Teaching: Elaborating involves further synthesizing by adding meaning to a concept, statement, episode, visual image, gaps in information, a question or product. Students can be made aware of semantic, visual and kinesthetic elaborations, and how to bridge gaps in information. Information may be vague, so determining the intent of information may be necessary. Whether it persuades, regulates, generates emotions or stimulates divergence, this awareness can aid in bridging gaps in meaning and adding detail. Metaphors, analogies and models can be used to elaborate ideas.

Application:

- Describe illnesses like measles, mumps, bronchitis, etc. in terms of a metaphor. Measles are like _____because _____.
- Sentence elaboration might involve the process of Subtract 1 Word, then Add 2 Words. Select a sentence that is vague or needs help, and apply the elaborating process. The meaning and noun must remain constant, e.g.,
  The tree **fell.**
  - take away fell
  - add crashed forward

  The tree **crashed forward**.
  - take away forward
  - add fraying and downward

The **fraying** tree crashed downward.
- take away fraying
- add splintering, hollow

A **splintering, hollow** tree crashed downward.

- Mime an activity or process of discussion. Have one person in a group begin the mime and others spontaneously add actions to enhance meaning and interest in the situation. Challenge students to keep the process going, e.g., cleaning a house; searching for a lost object.
- Mime a use for an unstructured object. Challenge others in the group to mime a different use for a cloth, ruler, crumpled paper or box. Miming the use of objects related to a theme of study (a tanned fur, a thermometer, a rope) can build knowledge of attributes and relevance to study.
- Role playing and miming a dialogue in a problem-solving situation can enhance empathy, e.g., a new prairie settler trying to trade possessions for wheat seed or furs; a parent confronting his child for being late.
- Elaborate a mathematical equation.
  $8 + 6 = 14$ or $(24 \div 3) + (3 \times 2) = 14$
  The second series can be further elaborated.
- Use a group drawing process to elaborate an idea. One student draws a portion and other students continue to add to and then title the drawing.
- Students' own art work can be elaborated on several working occasions, focussing on adding detail with the same media. Another medium might be used to enhance detail, e.g., charcoal, felt pen, yarn, ink or other complementary media.
- Generate elaborative ideas for creative writing. Write a topic on top of blank page and randomly pass topics through class with each receiving member adding details to the main idea. Retrieve original topic and use as a springboard for writing.
- Mind mapping is a useful tool to elaborate on an idea or theme. It can be used in researching, writing, or oral presentation. A thought or idea is represented by a single word or phrase and a line. Connecting ideas are added with continuing lines and words. A unit or period of study can be mind mapped to summarize information. It can be used in any subject at the end of a period to highlight ideas of importance. New ideas can be mind mapped in different pen colours or through the use of sketched images. Buzan (1983) discusses this technique.

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Evaluating

Definition: Evaluating involves assessing the value, reasonableness and quality of an idea related to a stated purpose.

Skill Attributes: Ideas are weighted to determine desirability or worth. Evaluating includes generating criteria and confirming ideas. It can involve personal evaluation or issue evaluation. Criteria can be quantitative or qualitative and can be combined in the evidence gathering. Evaluating is key to monitoring a task and self.

Direct Teaching: Students can begin making judgments based on established criteria or by examining personal likes or dislikes, or the benefits and burdens of a situation or process. The pros and cons of an issue can be examined. Criteria or standards can be set for judging the value or logic of an idea. Developing and applying criteria can be problematic if performed inappropriately. Categories of judgment must be clearly laid out and can include time relationships, casual, relevancy, equivalence, quantity, quality, means/ends, or theory/practice. Criteria categories must be defined and a rating system determined. Rating systems can include:

1. Scale of several steps
   - 5,m4,m3,m2,m1
   - outstanding, excellent, very good, good, fair

2. Continuum

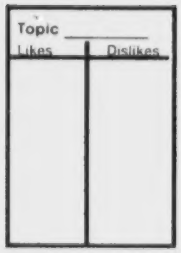
   _____
   low high

3. 2-point rating
   - like/dislike
   - pros/cons
   - benefit/burden
   - satisfactory/unsatisfactory

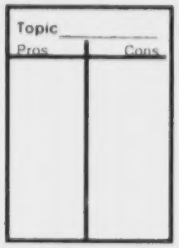
4. Anecdotal comments

See Appendices D-1, D-2 and D-3 for sample evaluation forms.

Application:
- Explore the likes and dislikes of being the oldest or youngest member of the family. Equalize the information generated on both sides to attain a balanced viewpoint. Attitude change can occur when looking at the positive side.



- Explore the pros and cons of an issue such as lengthening the school year. The pros and cons can be explored from the student's, parent's and teacher's point of view.



- de Bono's (1980) "PMI" presents a method of generating the plus, minus and interesting factors of an issue. de Bono's (1985) "Six Thinking Hats" are particularly useful in mapping out factual thinking—white hat, positive thinking – yellow hat, negative thinking – black hat, emotional thinking – red hat, creative thinking – green hat and blue hat, combined thinking. This process can help categorize different kinds of thinking on an issue and combine ideas into a position.

ISSUE :		
Plus	Minus	Interesting

- A survey can be used to verify a hypothesis, e.g., people are concerned about our environment.
- Determining how substantial and reliable information is can be essential to learning. Discuss vague and ambiguous claims and overgeneralized and slanted

information that cannot be supported. Present students with faulty or ambiguous information. Have them look to many sources to confirm accuracy of information. Locate slanted and overgeneralized information in newspapers, magazines, advertising and news broadcasts.

- Select a topic of local controversy and collect viewpoints. Determine which viewpoints are substantial and which unreasonable.
- Kholberg's levels of moral reasoning (Galbraith and Doves 1976) can be used at a senior level to explore moral positions on an issue.

Decision Making

Definition: Decision making is a process of using criteria to weigh alternatives and generate a judgment.

Process Attributes: Decision making, although included as a sample skill, is a process combining multiple strategies. It is closely related to problem solving and is sometimes viewed as subset of the broader problem-solving process that includes making many decisions. Decision making can involve competing alternatives that can be compared to criteria. Decisions can range from small everyday choices to more complex decisions. It is a process that constantly engages in analysis, synthesis and evaluation. A systematic decision-making process can facilitate effective judgment.

Direct Teaching: A process of decision-making among the many available can be selected for direct teaching. Steps include:

- Determining alternatives
- Setting criteria
- Weighing alternatives against criteria
- Arriving at a decision and giving reasons for choice

In initial teaching, a limited number of alternatives can be provided or decisions generated with preset criteria.

Decision: Buying a present for a friend. Students can generate alternatives that can be rated against teacher criteria.

2 book 3 2 7 total	1 pet 1 3 5 total
3 gift voucher 3 3 9 total	3 clothing 2 3 8 total

Scale: Value low high

Criteria:				
•	is practical	1	2	3
•	can be afforded	1	2	3
•	will be appreciated	1	2	3

Criterion value in this example is preset and individuals can rank their generated choices. High total of criteria is considered as a selection. Reasons can be given for accepting or rejecting choice.

With young children, happy faces or simple scales such as yes, no or maybe can be used as scales in place of a number rating. Once students have practised weighing others' criteria against their own alternatives they can advance to generating their own criteria. Criteria can often be listed in the form of questions:

- How expensive is it?
- How acceptable or enjoyable is it?
- How safe is it?
- How much time will it take?
- What resources will be required?
- Will it be original?
- Is it worth it?

Larger numbers of alternatives can be generated and prioritized. Five alternatives can be selected from a list of 15. A grid system such as the one in Figure 10 can be introduced to weigh alternatives. The grid systems in this section are adapted from the work of Joyce Juntune (1984).

Decision-Making Grid

Decision: In what part of Alberta would it be most desirable to live?

Rating Scale: 5 – excellent 4 – very good 3 – good 2 – fair 1 – poor	CRITERIA					
	Are there jobs available?	Is it an enjoyable place to live?	What is the cost of living?	How accessible is it to services I require?	What are opportunities for the future?	Total*
ALTERNATIVES						
Great Slave Lake	3	4	4	3	3	17
Lake Louise	2	5	3	3	3	16
Pincher Creek	3	3	4	3	3	16
Lethbridge	4	3	4	4	4	19
Edmonton	4	4	3	5	4	20

*Next Step: Accept, Modify or Reject Solution

Figure 10

Decisions may not rate out according to expectations. Criteria may be reviewed to see if they were of the highest priority and the honesty in ratings can be reviewed. Other alternatives can be considered. Decisions must be made to hold, accept or reject solutions. Further weighing of high-priority criteria and alternatives may be required. Prioritizing may include giving criteria and alternatives a numerical weight and multiplying the ratings may further discriminate critical elements and produce a different solution.

A system of solution modification may be required to improve or combine several ideas to produce a stronger idea. Alternatives can be viewed from examining both positive and negative consequences. Means to lessen negative consequences can be explored. Alternatives close in value can be compared with each other to aid selection.

Comparison of Alternatives

Decision: Where should I spend summer vacation?
Alternatives are compared with each other.
Numerical totals can influence choice.

Criteria: What choice would produce the greatest satisfaction?		Visiting a friend	Two weeks at the lake	Tennis camp	Visit Vancouver Island	Outdoor camping	Total number of times selected
		A	B	C	D	E	
Visiting a friend	A		B	A	D	A	2
Weeks at the lake	B			B	D	B	3
Tennis camp	C				D	C	1
Visit Vancouver Island	D					D	(4)
Outdoor camping	E						0

Figure 11

Application:

- Decide on the most effective way to increase your vocabulary.
- Decide on topic for independent research.
- Decide on additional after school activities.
- Decide most effective application of math concepts being learned.
- Decide on recess activity.
- Decide on best means of surviving a difficult situation.
- Decide on product to be manufactured in class small business project.
- Decide on possible future career choice.
- Decide on courses to be taken in the next year of high school.
- Decide whom to vote for in an upcoming election.
- Decide on method to enhance teaching thinking skills.
- Decide who was the best premier of Alberta.
- Decide who was the greatest scientist or artist.

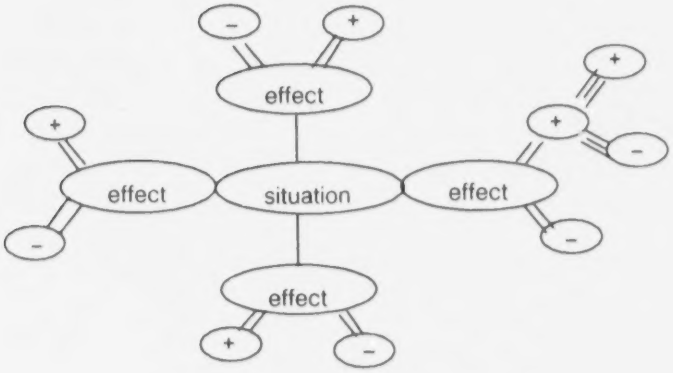
Forecasting

Definition: Forecasting is understanding the cause and effects of a particular idea or action.

Skill Attributes: Forecasting involves making predictions on observations, relationships, and on

changes of ideas or actions. Predictions may include positive or negative effects. It is a useful strategy to use before putting a decision into action. "What if" situations facilitate predicting.

Direct Teaching: Students can consider all possible causes or effects/results of a particular situation or action. Strongest to weakest causes and effects can be rated using a numbering scale or with + and –. The strongest cause and effect relationship can be identified along with reasons for that choice. Examine negative and positive effects of a situation by using the format below.

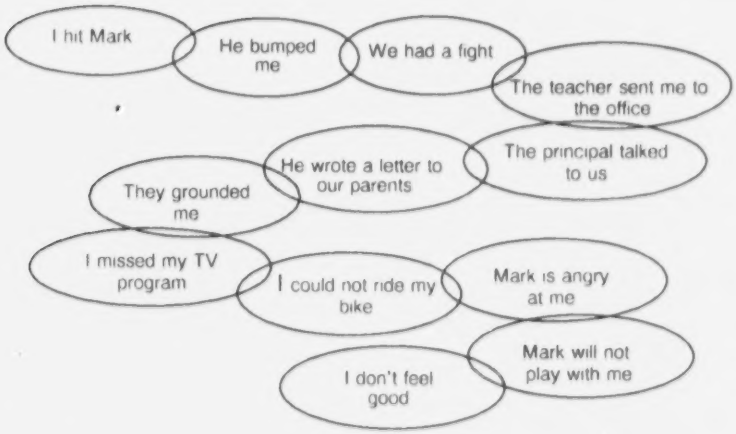


This process broadens the view of a situation, can direct modification of a decision, examination of the many aspects of an issue and taking a position on that issue.

Application:

- Discuss causes and effects of taxes.
- Discuss causes and effects of acid rain.
- Forecast the feasibility of having a chicken for a pet.
- What if people lived to 120 years of age? What could be the causes and effects of this change?
- Forecast level of student thinking skill development after six consecutive years of involvement in the elementary grades. What effects will this have on junior high programming?
- Create an effects chain based on a behavioural issue or problem-solving situation.

An Effect Chain: A follow-up chain may be created to reverse the condition of "I don't feel well."


I hit Mark
He bumped me
We had a fight
The teacher sent me to the office
The principal talked to us
He wrote a letter to our parents
They grounded me
I missed my TV program
I could not ride my bike
Mark is angry at me
Mark will not play with me
I don't feel good

Planning

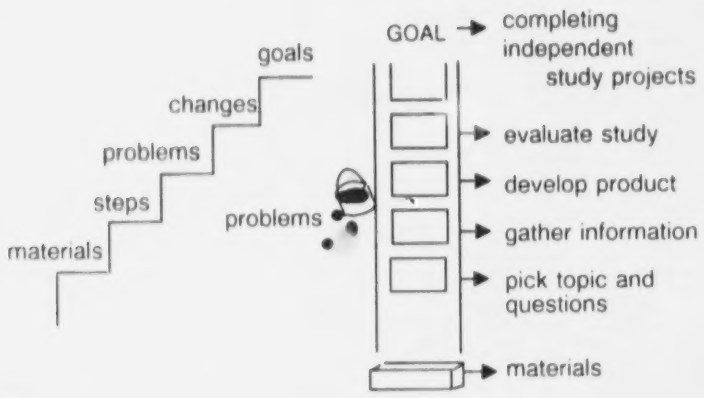
Definition: Planning is a method for achieving a specific goal or outcome.

Skill Attributes: Planning is a process of taking ideas from generation to action. This can involve the setting of a process to follow in designing a product or achieving an outcome. Steps of the process can be interchangeable depending on the task and can be applied to group or individual planning. Long- or short-term outcomes, or concrete and abstract events can be planned. A time element can assist planning. Planning facilitates independence.

Direct Teaching: Procedures can be student generated. Specifics might include:

- What do I want to accomplish?
- What materials/resources do I require?
- What procedures will I follow?
- What are some problems I might encounter?
- How can I overcome these problems or adjust my procedures to still accomplish my outcome?

Procedures may be sequenced or altered for a particular task. Subgoals with time estimates may be required for long-term planning. Reverse planning can be used to outline steps in a complex planning process. Plans can be written or sketched but should be visualized and recorded in some form. Checklist can assist students in monitoring their own planning. Young students can use a step or ladder system to assist them in visualizing the process. Appendix E describes another planning format.



Application:

- Plan to teach a foreign student rules of punctuation in English.
- Plan a snowman, a graph, going on a field trip, a class booklet on a topic, a meal, your day, your week or your year.
- Plan a story or other piece of creative writing. Procedures might include:
  - what story is about
  - characters, settings
  - sequence of events
  - problem situations
  - resolving the situation
- Plan to survey a group of people to gather information.
- Design an experiment to answer questions about the behaviour of mould.
- Plan a video presentation on a topic of study.

Communicating

Definition: Communication is expressing thoughts and ideas to others.

Skill Attributes: Communication involves directing thinking skills and processes to expressing information. Communication combines ideas that can include sensory observations, feelings, concrete and abstract categories, analogies and non-verbal actions to express intent or systems of meanings and thought. Systems of ideas include oral, visual, kinesthetic and written forms. Figure 12 provides examples of each type. Questioning is a means of communicating.

Direct Teaching: Experiences in using sensory data, feelings, concrete and abstract categories, analogies and non-verbal communication are necessary to build

the concept of expression. Understanding that a variety of modes of communication exist, that there are forms of preference and that ideas can be translated from one form to another, is essential to building this skill. Understanding the meaning of audience and matching the medium with the message are also necessary.

Application:

- Describe ideas within sensory categories:
  - looks like _____
  - feels like _____
  - smells like _____
  - tastes like _____
  - sounds like _____
- Create an analogy based on sensory information.
- Describe ideas in relation to concrete and abstract categories, e.g., as round as, as tall as, as fast as, as ugly as.
- Create feeling calendars for self or story character. Record feelings for a week or a month. Reflect on patterns of feelings.
- Describe ideas in relation to other ideas, e.g., White is to black as up is to down.
  _____ is to Hitler as _____ is to Churchill.
  The line for the movie was as long as _____.
  Spring is to _____ as
  _____ is to _____.
- Translate an oral or written form of communication to a non-verbal form.
- Create systems of communication that combine at least two forms—oral, visual, kinesthetic and written.
- Design a brochure based on the study of a topic.
- Design a record cover based on a position taken or an issue.
- Create a quotation collage on a theme.

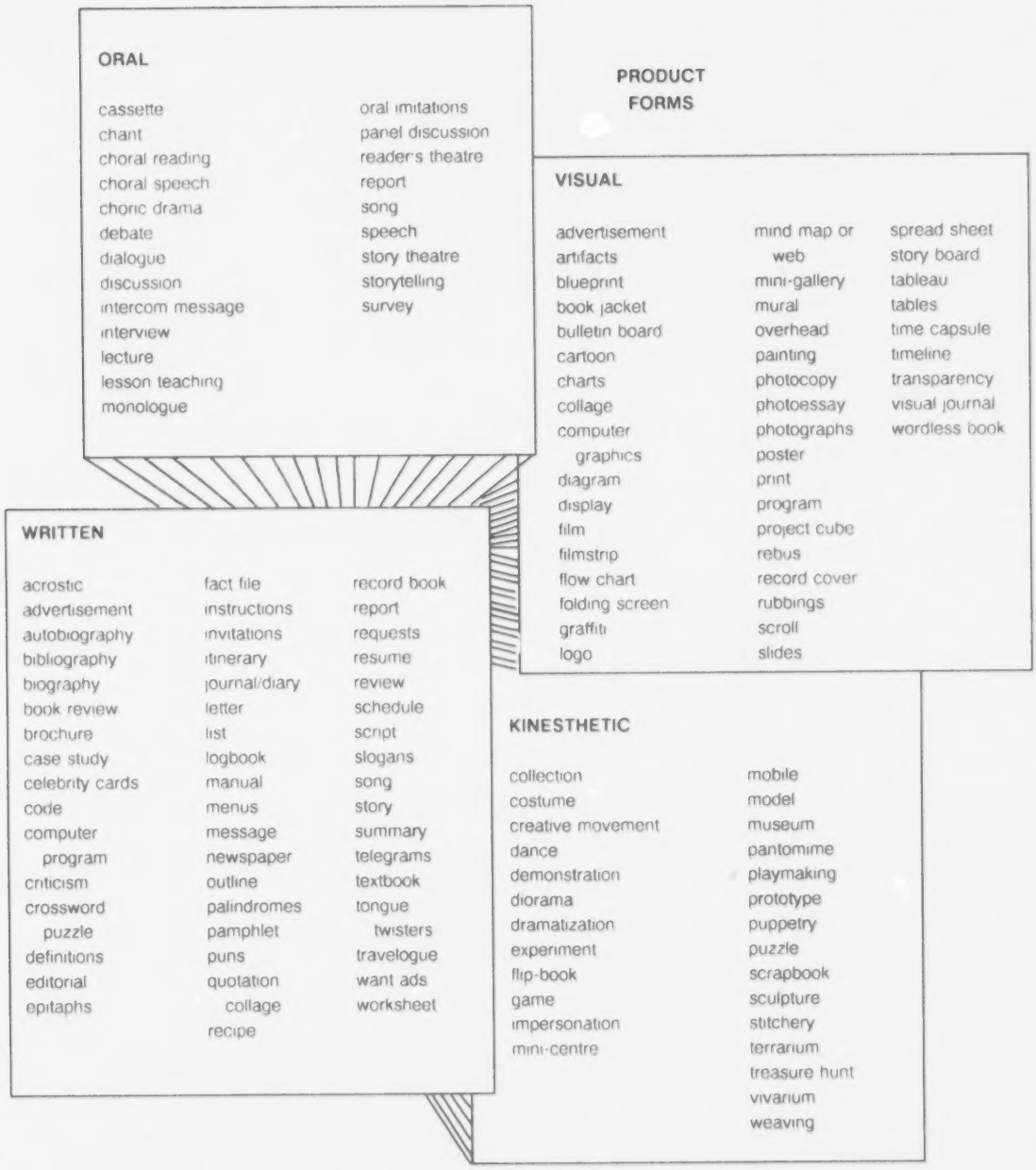

PRODUCT FORMS
ORAL
cassette
chant
choral reading
choral speech
choric drama
debate
dialogue
discussion
intercom message
interview
lecture
lesson teaching
monologue
oral imitations
panel discussion
reader's theatre
report
song
speech
story theatre
storytelling
survey
VISUAL
advertisement
artifacts
blueprint
book jacket
bulletin board
cartoon
charts
collage
computer graphics
diagram
display
film
filmstrip
flow chart
folding screen
graffiti
logo
mind map or web
mini-gallery
mural
overhead
painting
photocopy
photoessay
photographs
poster
print
program
project cube
rebus
record cover
rubbings
scroll
slides
spread sheet
story board
tableau
tables
time capsule
timeline
transparency
visual journal
wordless book
WRITTEN
acrostic
advertisement
autobiography
bibliography
biography
book review
brochure
case study
celebrity cards
code
computer program
criticism
crossword puzzle
definitions
editorial
epitaphs
fact file
instructions
invitations
itinerary
journal/diary
letter
list
logbook
manual
menus
message
newspaper
outline
palindromes
pamphlet
puns
quotation collage
recipe
record book
report
requests
resume
review
schedule
script
slogans
song
story
summary
telegrams
textbook
tongue twisters
travelogue
want ads
worksheet
KINESTHETIC
collection
costume
creative movement
dance
demonstration
diorama
dramatization
experiment
flip-book
game
impersonation
mini-centre
mobile
model
museum
pantomime
playmaking
prototype
puppetry
puzzle
scrapbook
sculpture
stitchery
terrarium
treasure hunt
vivarium
weaving

Figure 12

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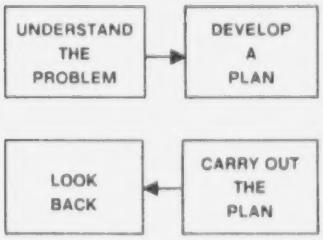
Problem Solving

Definition: Problem solving is a process that combines creative and evaluative skills into a workable strategy for task solution. It involves making numerous decisions.

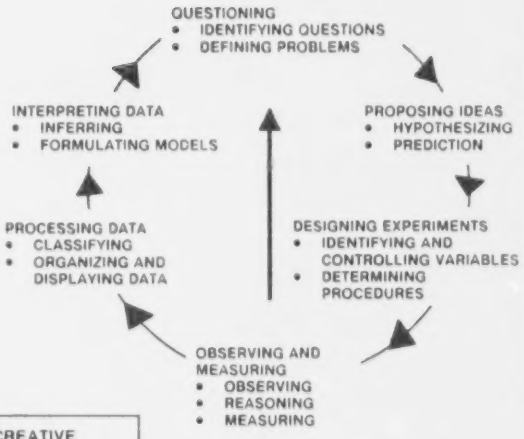
Process Attributes: The skills presented in this chapter and others combine to give human beings the ability to solve problems. It is claimed that problems are the heart of creativity and the linking process. Individuals will combine skills in unique ways to explore a problem, to create alternatives and solutions, to evaluate ideas and to carry a solution into action.

Direct Teaching: Procedures of solving a problem may be student generated. Problem-solving models are readily available with many being discipline specific. Below are several models. Students can explore the various models, reflect on similarities and differences, and adapt or create a model for their own personal use or for the task at hand.

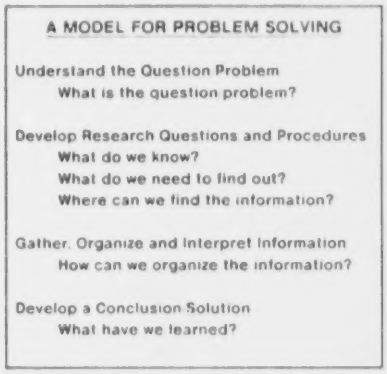
MATHEMATICS
Problem-Solving Method

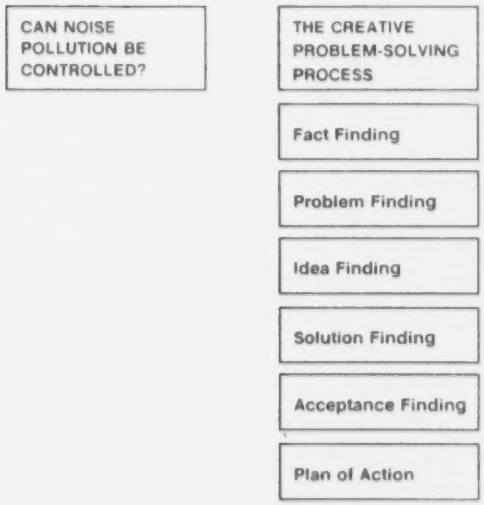


SCIENCE
Process Skills

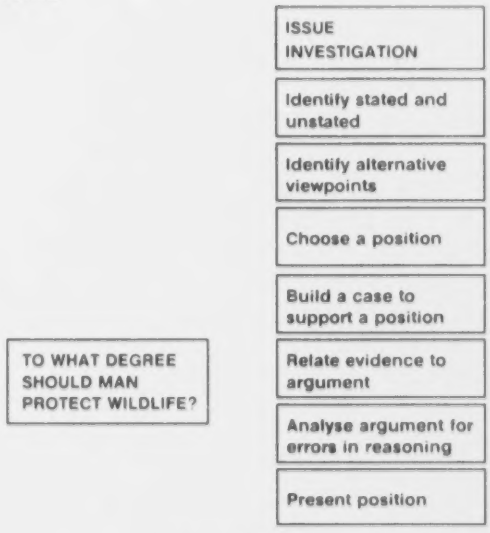


SOCIAL STUDIES
Problem-Solving Model


A MODEL FOR PROBLEM SOLVING
Understand the Question Problem
What is the question problem?
Develop Research Questions and Procedures
What do we know?
What do we need to find out?
Where can we find the information?
Gather, Organize and Interpret Information
How can we organize the information?
Develop a Conclusion Solution
What have we learned?



CREATIVE PROBLEM-SOLVING PROCESS


TO WHAT DEGREE SHOULD MAN PROTECT WILDLIFE?
ISSUE INVESTIGATION
Identify stated and unstated
Identify alternative viewpoints
Choose a position
Build a case to support a position
Relate evidence to argument
Analyse argument for errors in reasoning
Present position

ISSUE INVESTIGATION PROCESS

Figure 13

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Elements of problem solving include:

- Recognizing and defining the nature of a problem.
- Deciding on and sequencing the processes needed to solve a problem.
- Allocating mental and physical resources to a problem.
- Evaluating and regulating one's solution process.

Sternberg (1985) provides us some insights into the nature of real-life problems. They are:

- The most difficult step in problem solving is recognizing a problem exists.
- The process of figuring out how to solve a problem can be more difficult than the solution itself.
- Everyday problems tend to be ill-structured; it is not always clear what information will be needed to solve the problem, nor where it can be found.
- Solutions to everyday problems depend on and interact with the context in which problems are presented.
- Criteria for the "best" solutions to an everyday problem are sometimes difficult to define.
- Solutions depend as much on informal knowledge as formal knowledge.
- Solutions to everyday problems may hold important personal consequences.

Real-life problems can be complicated and persistent. Problems can become more issue based where there is no one solution, only a well-rationalized position. An issue process is described in the problem-solving models presented. Issues involve taking a position for or against an idea, and can include examining beliefs and values that are beyond regulatory measures.

Instruction in problem solving and issue resolution should range from exploring well-defined problems to those that are ill defined. It is important that specific problem-solving skills are practised and extended to real problem situations. Problem solving and issue resolution should be part of all courses of study. The opportunity to apply knowledge in an interdisciplinary way can challenge and facilitate independent learning.

Application:

- Debate the issue of whether shopping malls are better than corner stores.
- Explore how prejudice can be overcome.
- Explore means to generate claim rating for items in the Lost and Found Box.
- Solve the problem of newcomers to a school feeling out of place and out of touch with operational information.
- Solve the problem of integrating thinking skills into all subject areas for all students.
- Solve the problem of investing your money wisely.
- Take a position on how man has influenced change in our environment.
- Take a position on whether individual rights are more important than group rights.

- Take a position on the degree to which man should protect wildlife.
- Take a position on which rules should govern the admission of immigrants into Canada.
- Take a position on survey and opinion polls. Investigate their validity and influence on society.

In summary, the skills in these sections are a sampling of the sometimes overwhelming number of ways to describe thinking operations. Teachers are encouraged to generate other skills, combine similar skills and select a small number for initial application. Exploring means of integrating these skills into a subject can be an exciting process. The application examples provided are intended to be only a beginning.

Integration of Thinking Skills into Subjects

Content and subject areas represent particular patterns or organizations of knowledge and processes. Thinking does not occur in a void but in relation to content. In planning subject area integration several questions must be answered:

- What are some of the key concepts, values and methodologies in this content area?
- What skills and dispositions do students need to demonstrate to be competent in this area?
- How are these skills and attitudes developed at other grade levels? What grouping of skills and processes are necessary at this grade level?
- How is the process of decision making and problem solving aught in this area?
- How can the thinking skills and attitudes become meaningful to the student in this area?
- How can changes and trends in subject area concepts and methodologies be accommodated?
- How can mastering a skill in a discipline be transferred to other areas and real-life experiences?

It is incumbent on curriculum developers and teachers and staff to analyse subject areas to determine the best avenue of enhancing the subject areas as well as student thinking. As teachers get into the complex task of sequencing thinking skills it is necessary to increase the complexity of the skill and the task, to locate divergent areas of application of content and to shift responsibility for learning from teacher to learner.

Various subject areas will be examined in relation to thinking skills and dispositions. Table 5 demonstrates the beginning of subject area analysis. Some typical thinking embedded in that content is identified and some possibilities for enhancing thinking are suggested. Table 6 provides examples of skills and processes integrated into general subject areas. It illustrates that any of the skills can be integrated into any subject area.

Table 5

ANALYSING SUBJECT AREAS FOR INTEGRATION

	SCIENCE	MATH	SOCIAL STUDIES	LANGUAGE ARTS/ENGLISH
Key concepts	• to enhance understanding of the natural world	• to interpret the world through models of pattern, quantity and number	• to construct meaning of the changing society	• to construct and communicate meaning
Methodologies prescribed	• science process skills	• computation and problem-solving approach	• use of inquiry strategies in problem solving and decision making	• an integrated holistic approach that inter-relates speaking, reading, writing and presenting
Some typical thinking skills embedded	• questioning • observing • measuring • researching • inferring • hypothesizing • experimenting • interpreting • decision making • problem solving	• recalling • comprehending • analysing • applying • problem solving • patterning	• analysing • patterning • problem solving • decision making • predicting • evaluating • researching • synthesizing • questioning	• associating • comprehending • analysing • patterning • inferring • verifying, evaluating • forecasting • synthesizing • decision making • problem solving
Attitudes often developed	• explanations of natural phenomena	• one usually standard answer	• many possibilities	• many possibilities
Metacognitive processing	• clarifying (ask a teacher or peer to clarify a definition or relationship; struggling with contradictions, inconsistencies and misconceptions) • verifying (raising questions about the adequacy of information) • evaluating new ideas and testing them against prior knowledge • revising earlier thoughts • withholding judgments until all the information is in • monitoring time and energy			
Possibilities for enhancing thinking in subject area	• more application to real-life problems and situations			
	• more analysing and composing of data • more evaluation of processing • more verifying of data • more synthesizing of findings • more decision-making opportunities	• capitalizing on errors • a total problem-solving focus • more application of computational abilities • analysing and patterning of computational strategies and concepts • more synthesizing and verifying activities	• verifying data from a broad range of sources • expressing ideas from various points of view • greater exploration of the sources of attitudes, beliefs and values of self and others	• more synthesizing and decision-making opportunities • elaborating ideas to enhance meaning and interest • creating of patterns of meaning • seeking information from many viewpoints
Teaching strategies	Greater use of mediative, generative and collaborative strategies			

Table 6

INTEGRATING THINKING SKILLS INTO SUBJECT AREAS

LANGUAGE ARTS ADD DETAIL TO A SENTENCE IN TROUBLE **ELABORATION**	**SCIENCE** SKETCH THE WATER CYCLE **VISUALIZING & PATTERNING**	**HOME ECONOMICS** CREATE YOUR OWN RECIPE FOR MUFFINS **SYNTHESIZING**	**SOCIAL STUDIES** GRAPHICALLY DEPICT THE RIEL REBELLION **PATTERNING**	**MUSIC** LIST THE DIFFERENT USES OF MUSIC IDEA — CATEGORY **CATEGORIZING**
PHYSICAL EDUCATION PRESET PERSONAL GOALS FOR A GYMNASTICS LESSON **GOAL SETTING**	**INDUSTRIAL ARTS** PLAN CONSTRUCTION OF A STORAGE BOX **PLANNING**	**TYPING** TYPING IS LIKE A SNOW-STORM BECAUSE **COMMUNICATING**	**MATH** METRIC SYSTEM for | against **EVALUATING**	**BEAUTY CULTURE** FORM A GENERALIZATION BASED ON CHARACTERISTICS OF HAIR **PATTERNING**
SCIENCE PLAN A SCIENCE EXPERIMENT TO TEST LEVERS **PLANNING**	**DRAMA** IMAGINE WALKING THROUGH A COLD WINTER STORM DRAMATIZE **VISUALIZING & SYNTHESIZING**	**SOCIAL STUDIES** ALL SCHOOLS WILL BE HELD IN IGLOOS causes | effects **FORECASTING**	**HEALTH** DECIDE ON THE BEST WAY TO SURVIVE A DIFFICULT SITUATION **DECISION MAKING**	**LANGUAGE ARTS** SKETCH IMAGES OF DIFFICULT VOCABULARY **VISUALIZING**
MUSIC ADD DETAIL TO SIMPLE MELODY TO ENHANCE INTEREST **ELABORATING**	**DRAMA** ROLE PLAY DECIDING TO STAY OUT LATE OR BE HOME ON TIME **DECISION MAKING**	**ART** COMPARE STYLE OF TWO DIFFERENT ARTISTS alike | different **PATTERNING**	**MATH** MEASUREMENT IS LIKE A WINDOW BECAUSE **COMMUNICATING**	**COMPUTING SCIENCE** A NEW COMPUTER practical features | impractical features **EVALUATING**
HEALTH DECIDE ON A CAREER TO INVESTIGATE **DECISION MAKING**	**MATH** DESIGN A MATH PUZZLE **SYNTHESIZING**	**SCIENCE** TAKE A POSITION ON THE ISSUE OF GENETIC ENGINEERING **ISSUE RESOLUTION**	**ART** DRAW ALL THE THINGS YOU ASSOCIATE WITH ARROWS ON THE PAGE **BRAINSTORMING**	**ECONOMICS** PREDICT REAL ESTATE PRICES FOR 1990 **FORECASTING**

Teaching for Transfer

Transfer is moving beyond the lesson. It is the carrying of a skill or knowledge to a new context. Driving a car does not ensure that one can drive a boat, a semi-trailer truck or a motorbike. There is basic knowledge from the original driving experience that would assist the task, but there are also gaps to bridge before the skill of driving becomes automatic in the next context.

Transfer, much as it is an educational expectation, does not occur easily. Skill and knowledge can be specialized and not always easily transferred. It appears to occur when surrounding attributes are similar and there is a perceptual similarity to the original learning experience. It can also occur when the learner abstracts a general rule or principle with the intent of using it elsewhere.

For example, to ensure the transfer of the skill of evaluating, a teacher might structure a situation very close to the original learning experience. In one instance, the likes and dislikes of a situation are discussed and in the second the "fors and againsts" are discussed. On the other hand, if a broader transfer is desired, the teacher can guide the learner to abstract the rules of evaluating and apply them when looking at a current political decision and determining its "pros and cons." By redirecting the attributes of evaluating, students can begin to see new connections and the benefits of a system of evaluating all ideas. The attributes of a skill need to be linked to the new context.

Analogies are useful strategies to redirect skill knowledge outside the present context. Thinking skills, with some of their generic attributes, have the advantage of being able to cut across discipline boundaries. By guiding student attention and practice opportunities, patterns of good thinking can become more general in nature. Table 7 shows how the skill of synthesizing can be integrated into various subject areas.

Transfer appears to occur where there is awareness and control of self and of the process being applied. The teaching of skills must be purposeful, with a conscious awareness of the task and self on the learner's part. In this way, we can encourage and support the transfer of skills taught in school to all areas of students' lives.

Table 7

INTEGRATING THE SKILL OF SYNTHESIZING INTO SUBJECT AREAS

MATH	**SCIENCE**	**SOCIAL STUDIES**	**LANGUAGE ARTS/ENGLISH**
Develop formulas or equations describing everyday occurrences. **SYNTHESIZING**	Create career descriptions for science related jobs of the future, e.g. ecotect or a skysitter. **SYNTHESIZING**	Create the recipe for a perfect friend or neighbour. **SYNTHESIZING**	Publish a history of the school or publish a community directory. **SYNTHESIZING**
ART	**PHYSICAL EDUCATION**	**COMPUTING SCIENCE**	**HEALTH**
Combine the impressionist techniques with surrealist style to create an image. **SYNTHESIZING**	Create an original relay for school trackmeet. **SYNTHESIZING**	Create a process to collect information on career choices. **SYNTHESIZING**	Create a logo depicting personal standards for healthy living. **SYNTHESIZING**
INDUSTRIAL ARTS	**MUSIC**	**ECONOMICS**	**DRAMA**
Create an original process of joining two pieces of wood together. **SYNTHESIZING**	Create an audiotape composition of musical phrases that depict "excitement," "moving on," "despair," or some other theme or emotion. **SYNTHESIZING**	Create an investment portfolio based on an imaginary $100,000. Calculate gains and losses over a specified period. **SYNTHESIZING**	Role play a conflict about returning an unsatisfactory consumer product. **SYNTHESIZING**

CHAPTER V

EVALUATING THINKING

This chapter examines the evaluation of student thinking and evaluation of programming for thinking in classrooms and schools.

Evaluating Growth in Students' Thinking

Educators should use appropriate evaluation techniques to assess thinking skills.

Assessing thinking skills demands a refocus in determining student growth and progress. Procedures must include not only factual knowledge students have gained as a result of a study, but the means they have used to solve a problem, to take a position on an issue, to reconceptualize or to create a new idea. The endpoint of extended thinking changes from one of reproducing to one of producing ideas and concepts at a higher level. The means of attaining results changes from measuring growth in recalling ideas to examining processes of analysing, evaluating, generating and predicting ideas. The discoverer, craftsman, evaluator and champion roles can be reflected on. Students move from greater reliance on external evaluation to becoming self-evaluators who instinctively monitor and regulate their thinking and involvements.

Thinking is very complex and no one test or measure can determine its total growth. How thinking is assessed will be determined by the expected direction, the outcomes and the content of learning.

What to Evaluate

It is essential to evaluate not only thinking skills but students' attitudes. As programming is planned, ideal skills and attitudes can be identified. Because growth of these skills and attitudes is not always immediately apparent, evaluation may have to be done over the long term to determine if developments are sustained. Evaluation should:

- identify growth in the thinking skills expectations identified in planning.
- measure student attitudes that might include increased flexibility of thinking, decreased impulsiveness, greater accuracy and a drive to continue even when a solution is not apparent.
- assess maintenance and transfer of skills beyond the learning situation.
- measure the ability to recognize and control one's thinking and the planning, monitoring and evaluating of skills and processes.
- identify other areas of improvement, such as self-esteem or good discussion skills.

Student evaluation also provides feedback on instruction tasks. If a skill or attitude is not being fostered this can direct the teacher to closely examine instruction tasks. A variety of approaches can be used to evaluate growth in student thinking:

- Teacher observations – anecdotal notes, videotapes, audiotapes
- Student developed self-evaluation measures
- Peer evaluation – can be used in conjunction with self/teacher evaluation, allowing learners to receive feedback on a task from many different sources.

- Student journals, writing and discussions
- Parent feedback – questionnaires, written feedback, conferences
- Appropriate tests
- A collection of student products (oral, visual, kinesthetic or written formats)
- Student thinking portfolios – a collection of student processes and products, including oral, visual, kinesthetic or written forms of idea exploration, idea generation and idea evaluation can provide examples of growth in thinking.
- Task-related questionnaire.

Self-evaluation

Criteria for evaluation can be teacher generated or developed in collaboration with students. As students begin to participate in setting evaluation criteria they begin to clarify their direction and goals. Student-generated criteria can be compared with teacher-generated criteria or that of other students. Comparing and combining attributes can create a strong self-evaluation tool. Teachers can also model use of formats.

If further data are required to test a self-evaluation measure, then the processes of famous historical thinkers, or identified skilful thinkers in the class, in the school or the community can be tested. Criteria can be modified as necessary. The skill of evaluating in Chapter IV provides information on developing different rating scales.

Establishing self-evaluation measures gives students ownership and clarity of direction. This understanding can promote the self-monitoring of thinking and action. Self-evaluation is essential to independent learning and thinking.

Ongoing Evaluation

Continual monitoring of student growth can include a total class perspective as well as a focus on individual strengths and needs. Data must be collected on an ongoing basis and progress recorded. Documenting of student thinking during discussions or by audio and videotapes can provide useful samples. Anecdotal notes made by teacher and students can record ongoing impressions of a discussion, focus on use of a skill or determine the transfer of information. Students' collections of samples of their own good thinking can provide material for examining progress made. Daily journals and occasional short questionnaires can facilitate evaluation of the task at hand.

A variation in assessment types does not in itself ensure effective thinking. Assessment types must be closely linked to content and skills and attitudes. Many standardized tests and written evaluation items assume one right answer. Although many tests can give us some valuable information, evaluation approaches need to further reflect student thinking processes, growth and needs. Assessment must capture and reflect student growth and needs. Carefully

developed criteria and approaches can reveal the quality of thinking behaviour and students' insights as well as honour their ability to self-evaluate. Evaluation procedures must provide students and teachers direction for improvement. As an appreciation for thinking processes is demonstrated in student evaluation, teaching and learning strategies will follow. Sample student evaluation procedures are found in Appendices D and F.

Evaluating Programming for Thinking

If schools are committed to extending student thinking the enhancement of teacher thinking must be part of the direction. Teacher thinking is the force that drives the development of effective programming. Identifiable teaching skills and strategies in the improvement of thinking can be learned, practised, reflected on and evaluated. Teachers' thinking and use of effective strategies grow in a climate similar to that of student thinking. In overall programming evaluation this must be an important consideration (see Figure 14). Other considerations are:

- Evaluation should include input from all major stakeholders.
- Assessment of the total school and classroom environments created for thinking is necessary.
- The effectiveness of the overall planning process must be assessed.
- Teacher effectiveness can be assessed through viewing teaching as a thinking process. Teacher and administrator collaboration in this process is essential. Teachers, like students, should become independent self-evaluators. Teacher decisions related to the following charted items can be evaluated by self and others.
- The decision-making effectiveness of parents, students and administrators in their related roles and responsibilities can also be assessed.
- Programming design, student assessment and evaluation procedures, nature of learning experiences and resources, and programming evaluation procedures can be reviewed on an ongoing basis.
- Methods of obtaining student, parent and staff perceptions may include questionnaires, surveys, interviews or conferences.
- Feedback should be used to revise and modify programming on an ongoing basis. Evaluation results should be communicated to all stakeholders.

Teachers' ongoing decisions in planning, accommodating student differences, analysing successes, monitoring improvements, transferring insights into action and working with others are an essential part of programming evaluation. Sample programming evaluation forms are found in Appendix G. Teachers and schools are encouraged to adapt and create evaluation procedures that are in line with the direction of their programming.

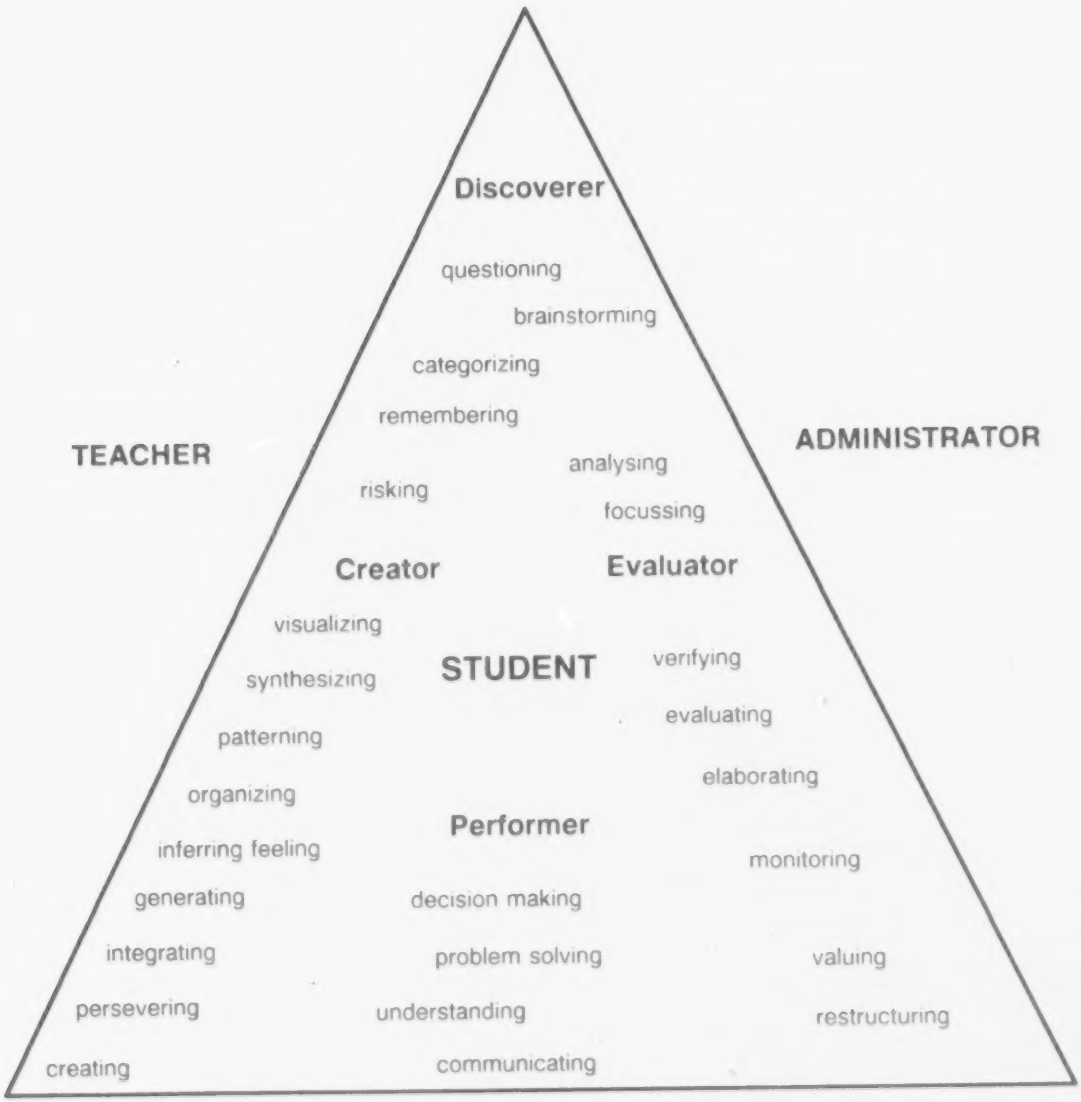
Classroom Climate and Organization	Instruction Strategies	Teacher Behaviours
• stimulating • purposeful • openness • self-directing • supportive	• uses a variety of directive, mediative, generative and collaborative strategies matched to the task at hand • integrative approach	• modelling • effective questioning that ranges from lower to higher level • effective responding behaviour • teaches for transfer

Figure 14

AFTERWORD

Across Alberta, good teachers are working to stimulate the thinking skills of their students. This resource book encourages teachers to make the teaching of thinking skills more deliberate and explicit. Therefore, we must make use of what is known about thinking—about critical reasoning, creative exploration and information processing. Room must also be made for what we don't quite understand. We have all had intuitive leaps, had insights or hunches that profoundly affect our lives and the lives of those around us. Perhaps we ought to encourage and trust our hunches and those of our students, more than we have until now. It is important to respect such thinking when it occurs and to encourage it where possible through enhancing students' independence and self-confidence.

Administrators and teachers can create a climate in which each student can progress from discovering to performing skills of thinking (see Figure 15). As educators explore ways of teaching for, of and about thinking, all students can learn new ways to think which will help them to live successful lives now and in the future.



SOME THINKING SKILLS PATTERNS

Figure 15

GLOSSARY OF TERMS COMMONLY USED

Cognition
Related to the various thinking processes characteristic of human intelligence. (See also "Thinking.")

Cognitive Modelling
A mediated learning technique through which teachers and students share their own thinking processes to gain some insights about how a particular idea can be understood.

Conferencing
An informal or formal meeting by a teacher with an individual or group, characterized by an interactive dialogue that provides an opportunity to identify strengths and weaknesses in thinking skill development and encouragement for continued thinking skill growth.

Convergent Thinking
Thinking that requires a single correct answer to a question or problem. (Compare with "Divergent Thinking.")

Creative Thinking, Creative Exploration
The act of producing or inventing original, new, novel, aesthetic or constructive ideas or products. (See also "Divergent Thinking.")

Critical Thinking, Critical Reasoning
Uses the basic thinking process to analyse arguments and generate insight into particular meanings and interpretations; also known as directed thinking.

Deductive Reasoning, Deducing
Inferring from what precedes. Leading to or drawing down to a conclusion. Deriving the unknown from the known. Opposite of "Inductive Reasoning."

Developmental Appropriateness
A consideration of student's intellectual, social/emotional and physical stages of learning development.

Divergent Thinking
The kind of thinking required to generate many different responses to the same question or problem. (Compare with "Convergent Thinking.")

Evaluation/Assessment
To make an examination or judgment based on a set of internal or external criteria.

Inductive Reasoning, Inducing
The process of combining one or more assumptions or hypotheses with available information to reach a tentative conclusion. Reaching a rule, conclusion or principle by inference from particular facts. Opposite of "Deductive Reasoning."

Information Processing
The representation of an aspect of thinking using a computer metaphor. Information is received by the senses and then "processed" by the mind resulting in certain actions, decisions, etc.

Intuition
Direct or immediate insight. A natural mental faculty; knowing without the use of rational processes.

Lateral Thinking
Thinking "around" a problem. Used to generate new ideas; related to divergent thinking.

Mediation
An ongoing interactive process where the mediator (usually the teacher) facilitates students' learning by engaging them in cognitive modelling, paired problem solving, reciprocal teaching and other mediated learning procedures where meanings are discovered, ideas are shared and challenged, and thinking is stimulated.

Metacognition
Thinking about thinking; being aware of one's own thinking processes.

Observing
A process of noting students' patterns of behaviour and using written documentation, such as anecdotal reports, keeping a journal, maintaining cumulative records, etc., to develop a picture of thinking skill development.

Paired Problem Solving
Using the skills of problem resolving with a partner or in group collaboration.

Point of View
The way one views or perceives the world based on a variety of physical, environmental, intellectual, cultural and emotional factors.

Problem Solving
Defining or describing a problem, determining the desired outcome, selecting possible solutions, choosing strategies, testing trial solutions, evaluating outcomes and revising the above steps where necessary. Not necessarily a linear process.

Reasoning
The intellectual capacity to comprehend, infer or think in orderly, rational ways. Has two forms: deductive and inductive, defined in this glossary.

Reciprocal Teaching

An approach to teaching where the students are gradually given the role of teacher as questions are generated, predictions advanced, points are clarified and ideas summarized. The goal of reciprocal teaching is to enable students to ultimately take control of their own learning.

Rote Learning

The use of memory through routine or repetition to acquire new information without relating it to their existing knowledge.

Thinking

The mental processes and skills we use to shape our lives.

Transfer

The extent to which students apply to their total life, what they have learned in one type of situation.

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1. I complete tasks when _____

2. My mind wanders when _____

3. I get tired and bored when _____

4. When I have a hard time paying attention I _____

5. I find classes interesting when _____

6. School is exciting when _____

My Strengths:	Areas in Need of Improvement:

Overall Task Plan For: _____ Appendix B1

Before Task	Planning Task	After Task
What I Know: What Else I Need To Know:	What Skills Will I Use: • •	What Did I Learn: How Well Did I Achieve My Goal:
Goal of Task: Subgoals: Date Due:	• What Resources Do I Need: • What Procedures or Steps Do I Follow: • What Might Go Wrong:	What Changes Did I Have to Make to Meet My Goals: For Next Time: Where Else Can I Use These Strategies:
Ideas and Feelings to Put on the Back Burner:		

Subgoal for Today: _____

Plan of Attack: _____

Evaluation:

How well did I achieve subgoal:

What Worked Well:

I Could Improve:

For Next Time: _____

Ideas, Feelings To Put on the Back Burner:

LEARNING/THINKING PREFERENCES

Appendix C1

There are different ways to think and learn. Indicate your preference by placing 3 – always, 2 – sometimes and 1 – seldom.

I prefer learning/thinking activities that:

0 allow me to list, match or recall ideas

0 allow me to summarize or explain information

0 allow me to construct and demonstrate ideas

0 allow me to compare and contrast ideas and create categories of ideas

0 allow me to reorganize information and create something new

0 allow me to judge and criticize ideas and predict future consequences

0 allow me to add interesting detail to something original to make it more interesting and meaningful

0 allow me to generate criticism to weigh alternatives in making a decision

0 allow me to plan ideas and actions in advance

0 allow me to communicate my ideas to an audience

I prefer learning/thinking:

0 alone 0 with a friend

0 with an adult 0 in a group

0 in a combination of ways — which combination

I prefer learning/thinking by:

0 reading books and magazines

0 listening to people talk or using a tape recorder

0 watching people, films or movies

0 putting things together and taking them apart

0 discussing ideas with others

0 playing a game 0 experimenting with things

I prefer sharing ideas by:

0 writing about it

0 telling about it

0 drawing or painting it

0 acting it out

0 building something about it

Rate Your Thinking

Appendix C2

Check items in each of the role areas, then cumulatively rate each role on a 1 – 5 scale.

Rate Your Discoverer

1	2	3	4	5
low				high

[ ] I am alert and observant.
[ ] I gather information using all my senses.
[ ] I look beyond the information presented.
[ ] I look for information in many and unusual places and sources.
[ ] I brainstorm possibilities and keep adding new ideas.

Rate Your Creator

1	2	3	4	5
low				high

[ ] I look at information from many perspectives and points of view.
[ ] I combine information in novel and unusual ways.
[ ] I embellish ideas to create meaning and interest.
[ ] I visualize new combinations and patterns of ideas.
[ ] I can put ideas on the back burner and let them simmer for awhile.
[ ] I can see humour in my ideas, follow intuition and feelings.

Rate Your Evaluator

1	2	3	4	5
low				high

[ ] I evaluate with criteria.
[ ] I recognize assumptions, fallacies and bias.
[ ] I make predictions, examine drawbacks.
[ ] I step outside my feelings.
[ ] I assess from others' points of view.

Rate Your Performer

1	2	3	4	5
low				high

[ ] I profit from criticism and error.
[ ] I forge ahead persistently.
[ ] I seek challenge and take risks.
[ ] I have multiple solutions to problems.
[ ] I create opportunities for others.
[ ] I capitalize on resources around me.
[ ] I follow through on tasks.
[ ] I bridge gaps in problems.

Name: _____

Students can draw, write or discuss their ideas in each category.

How do I find ideas?	How do I make new ideas?
How do I check ideas?	How do I make ideas work?

Rate Author's Use of Vivid Language						
Rate on 5 (high) to 1 (low) scale Criteria						
• use of adjectives and adverbs						
• use of visual images						
• use of sensory impressions						
Conclusion:						

Our Team Score

_____ for encouraging each other
_____ for solving the problem
_____ for planning and organizing the process

A B C D E Scale
↓ ↓
super needs work

Project Evaluation for _____
Topic _____ **Date** _____

Criteria	S	N	
• establishing questions • information accuracy • forming generalizations • organization • originality • self-evaluating			Comments:

Evaluating an Article, a Film, Lecture or Other Presentation of Information **Appendix D2**

1. Topic: _____

2. Questions that I think the article, film, lecture, etc. will answer.

_____ _____

_____

_____

_____

3. Further impressions and questions I have (jot down during experience).

_____

_____

_____

_____

4. Answer the questions you asked based on the presentation. Identify unanswered questions and other questions that were answered.

_____

_____

_____

_____

5. Where else can this information be used?

_____

_____

_____

_____

HOW WELL DO WE WORK TOGETHER?
PEER AND SELF-EVALUATION FOR YOUNG LEARNERS

Appendix D3

The following evaluation form is designed to have students rate themselves and others in how well they have worked together in groups. Students could generate the criteria for evaluation along with the symbols that would denote standards of achievement.

very well OK could be better

	Group Members			
	Myself	Sally	Tom	
Share Ideas				
Help Others				
Ask for Help				
Draw or write about what worked best.				

Task to Complete: _____	Deadline
Resources/Materials I Will Need Are: _____	
What Procedures Will I Follow? _____	
Problems that Might Arise: _____	
Changes I Need to Make:	

C. Evaluating My Thinking

Behaviour	Examples
1. Can use mistakes and errors and stepping stones for new ideas.	
2. Shows an awareness of thinking about own thinking.	
3. Shows an ability to go beyond the ideas presented.	
4. Links information with past experiences.	
5. Sorts and restructures ideas to create new meanings.	
6. Shows the ability to defer judgment.	
7. Can produce many ideas and shift perspective with ease.	
8. Generates, selects and applies criteria for evaluation.	
9. Plans, self-evaluates and monitors thinking.	
10. Develops standards for good thinking.	
11. Solves problems effectively with others.	
12. Other	

Specific skills and dispositions can be chosen in conjunction with the learner to create his or her evaluation form. The following sample highlights some general criteria for successful student thinking.

Profile of Student Thinking

Attitude Toward Thinking

	• demonstrates an awareness of personal attitudes and values
	• demonstrates an awareness of personal thinking processes
	• shows a willingness to take risks
	• displays the ability to capitalize on errors and failures
	• displays a sensitivity to new ideas
	• respects novelty and intuition
	• possesses a desire to explore ideas beyond what is presented
	• possesses a desire to reason well and base judgments on evidence
	• perseveres in searching for ideas and solution, even if not apparent
OAL	

Thinking to Create

	• demonstrates the ability to defer judgment and remain ambiguous
	• produces many ideas with ease
	• shifts perspective with ease
	• combines ideas in novel and unique ways
	• adds detail to enhance meaning and interest
OAL	

Thinking With Others

	• demonstrates an ability to empathize and respond to others' thinking
	• demonstrates an interest in attitudes, beliefs and values of others
	• demonstrates an enjoyment of special humour and comfort in discussing ideas with others
	• entertains different or opposing points of view
	• communicates to others effectively
	• expresses another point of view accurately
	• possesses a desire to reason well and base judgments on evidence
	• effectively solves problems or makes decisions with others
OAL	

Thinking for Understanding

	• searches for ideas and data to facilitate understanding
	• associates information to past experiences and ideas
	• searches for meaningful patterns among concepts
	• sorts and reconstructs ideas to create new meanings
	• applies new meanings in a variety of ways
	• alter goals and processes when gaps or errors are found
	• demonstrates the ability to plan, evaluate and monitor thinking
OAL	

Thinking to Evaluate

	• seeks information from several viewpoints
	• generates, selects and applies criteria for evaluation
	• verifies data and criteria
	• recognizes assumptions, fallacies and bias
	• approaches decision making and problem solving systematically
	• recognizes when evidence is insufficient
	• demonstrates an increase in thoughtful reflection
	• develops standards for good thinking
OAL	

Strengths:
Needs:

Levels of Achievement: 1. Directed, Awareness Level 2. Facilitated, Practice Level 3. Self-directed, Autonomous Level

OAL — OVERALL ACHIEVEMENT LEVEL

Project Self-Evaluation **Appendix F3**

Criteria and rating scale should be student generated and verified.

1. I defined my topic. needs improvement / well
   Comments: _____
   _____ _____
2. I collected sufficient information. some / a great deal
   Comments: _____
   _____ _____
3. I verified information. a little / well
   Comments: _____
   _____ _____
4. I combined, restructured and produced new information. ordinary / very creative
   Comments: _____
   _____ _____
5. I planned and regulated my time and organization. not very well / great
   Comments: _____
   _____ _____
6. I communicated my findings to others. so-so / well
   Comments: _____
   _____ _____
7. I evaluated my entire process. somewhat / well
   Comments: _____
   _____ _____

Highlights: _____

_____

_____

Improvements: _____

_____

_____

Assignment Self-Evaluation

Appendix F4

Name: _____

Date	Task or Activity	Successes	Problems Encountered

Students:	DIRECTED	FACILITATED	AUTONOMOUS
• provide examples to support thinking			
• piggyback on one another's ideas			
• post relevant questions and ask for justification			
• challenge other's ideas			
• relate specific ideas to more general concepts or principles			
• ask for clarification			

Comments:

not at all — sometimes — always

1. I contribute ideas and information.
   Comments: _____
   _____

2. I ask for clarification of ideas or more information.
   Comments: _____
   _____

3. I encourage others to share ideas.
   Comments: _____
   _____

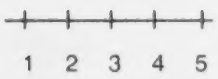
4. I help keep the group on task.
   Comments: _____
   _____

5. I explain ideas and processes to others.
   Comments: _____
   _____

6. I help keep the group organized.
   Comments: _____
   _____

For Next Time:

Rating of Programming Direction



Stakeholder perception of the achievement of major programming goals can be rated on a 5-point scale with suggestions for improvement stated below.

1. A school and classroom environment has been created that values and honours student thinking. _____

   Comments: _____

   _____

2. A clear understanding of the teaching of thinking is demonstrated by all stakeholders. _____

   Comments: _____

   _____

3. Programming dimensions and specific procedures for implementing and evaluating teaching for thinking have been established. _____

   Comments: _____

   _____

4. Teaching skills and processes to enhance thinking are integrated throughout the curriculum across grade levels. _____

   Comments: _____

   _____

5. Thinking skills are taught in an explicit manner. _____

   Comments: _____

   _____

6. Thinking is taught in a metacognitive context focussing on the planning, evaluating and regulating of one's own thinking skills and processes. _____

   Comments: _____

   _____

7. Instruction strategies that enhance student thinking are used on a regular basis. _____

   Comments: _____

   _____

8. Many opportunities for transfer of skills and processes into related content areas and real-life experiences are created. _____

   Comments: _____

   _____

Student Evaluation of Programming

Appendix G2

This form can be used by teachers, parents, administrators and programming coaches.

A student perspective of programming is also essential. A five-point rating scale can be used.

not at all — a great deal

1 2 3 4 5

1. Do I feel free to express and test my thinking in this school? _____
   Comments: _____
   _____

2. I understand my thinking and have some ways to improve it. _____
   Comments: _____
   _____

3. Thinking is important in all my subjects. _____
   Comments: _____
   _____

4. I have opportunities to make decisions about my learning. _____
   Comments: _____
   _____

5. Specific skills are taught to improve my thinking. _____
   Comments: _____
   _____

6. I have opportunities to think about my thinking and know how to improve planning it, checking it and changing it if necessary. _____
   Comments: _____
   _____

7. I have seen examples of good thinking in my teachers, parents, friends or others. _____
   Comments: _____
   _____

8. I have opportunities to transfer my good thinking to other areas. _____
   Comments: _____
   _____

9. Others around me value my thinking. _____
   Comments: _____
   _____

10. Other: _____
    Comments: _____
    _____

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This Classroom Observation Form can be used by a teacher to self-evaluate, by a peer coach or an administrator.

A. Climate and Organization Promote Thinking

Behaviour	Examples
1. The classroom climate is supportive and open to student thinking.	
2. Learning experiences are purposeful and well understood.	
3. Learning experiences and resources stimulate thinking.	
4. Students make decisions related to their learning.	
5. Student thinking is valued.	
6. Other.	

B. Instruction Strategies Promote Thinking

Behaviour	Examples
1. Thinking skills are explicitly taught.	
2. Mediating strategies are used to guide student development of effective skills.	
3. Generative strategies are used to create novel ideas and solutions.	
4. Collaborative strategies enhance student interactive skills.	
5. Self-evaluating and regulating strategies are used to monitor progress.	
6. Strategies are adjusted to meet student differences and needs.	
7. Metacognitive thinking is fostered.	
8. Other.	

C. Teaching Behaviours Promote Thinking

Behaviour	Examples
1. Teacher questioning ranges from low level to high level questions.	
2. Students apply knowledge of questioning to further inquiry.	
3. Teacher responds to student input in an open manner.	
4. Teacher extends student thinking through clarifying responses.	
5. Teacher models and shares effective thinking in actions.	
6. Teachers demonstrate a striving to plan, monitor and regulate their own thinking.	
7. Other.	

Examples of successful strategies can be recorded and compared over time. Behaviour items can become more specific as strategies are fine tuned and extended. Teacher input into the construction of an observation is essential to build ownership and understanding of direction.

AM I MODELLING WHAT I EXPECT FROM STUDENTS? Appendix H

Teachers may need a way to determine the effectiveness of their modelling. Evaluating modelling behaviours can be self-rated or performed by a colleague. This form may be of assistance.

Student Expectation:
Modelling Behaviours Planned:
Modelling Behaviours Achieved:
Greater consistency in my actions and expectations may be attained by:

Teaching Strategies Planning Chart

Appendix I

STRATEGY	DECISIONS					
	Goals Set by	Methods & Means Determined by	Evaluation, Effectiveness Determined by	Content Expectations	Student Characteristics	Skill Required
Directive	Teacher	Teacher	Teacher			
Mediative	Teacher	Student	Student			
Generative	Teacher Student	Student	Student			
Collaborative	Teacher Group	Group	Group			

Nature of Questioning:	Nature of Teacher Responses:	Nature of Modelling:

	To be considered	Exploring	Developing	Refining	Well established
Does your school community . . .					
1. Value enhancing student thinking as a goal of educating all students in all subject areas?					
2. Possess an understanding of student thinking and come to a decision on the major issues in teaching thinking?					
3. Agree on a long-term procedure/plan to facilitate teaching thinking?					
4. Support staff development and cooperative planning for teaching thinking?					
5. Assess student growth in thinking and use assessment results on an ongoing basis in planning programming?					
Does your school . . .					
6. Have expectations that all student growth can be enhanced through thinking?					
7. Agree on thinking processes/skills that are essential to being a skilful thinker?					
8. Develop learning experiences in all subject areas that integrate critical and creative thinking processes?					
9. Review and acquire thinking-oriented materials?					
10. Reflect and refine approaches to teaching thinking on an ongoing basis?					

Appendix J (contd.)

	To be considered	Exploring	Developing	Refining	Well established
Does your classroom . . .					
11. Present an atmosphere of openness, experimenting, idea testing—one that rewards student thinking and provides ongoing opportunity for decision making?					
12. Use thinking processes and methodologies to plan learning experiences?					
13. Allow students to reflect on thinking processes and make decisions related to their learning?					
14. Encourage student to student interaction where ideas, insights and effective thinking strategies can be discussed?					
15. Provide stimulating materials, organization and learning environments to further student thinking?					
16. Assess and evaluate student's creative and critical thinking processes in a variety of ways in all subject areas?					
17. Share successes with others?					
Do you as a teacher . . .					
18. Value student thinking as a primary goal in educating all students?					
19. Model exemplary thinking—withholding judgment and profiting from errors, and other characteristics of a skilful thinker?					
20. Encourage student to expand beyond the assigned topic?					
21. Use a variety of instruction approaches, reflect and refine them according to student needs?					
22. Communicate the appreciation of good student thinking?					

	To be considered	Exploring	Developing	Refining	Well established
23. Structure opportunities for transfer of thinking skills and strategies into all disciplines and real-life situations?					
Do your students. . .					
24. Assess their abilities as skilful thinkers?					
25. Plan long- and short-term objectives for their own learning?					
26. Collaborate with others to resolve problems or issues?					
27. Question ideas and seek clarification?					
28. Monitor and refine their own thinking and learning process?					
Do your parents . . .					
29. Understand the expectations of strategies to enhance thinking?					
30. Provide students with opportunities to practise new thinking behaviour?					

Priorities to Consider: _____

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SKILLS OF INTELLIGENCE AS FOUND IN TEACHER RESOURCE MANUALS

Prepared and Submitted by: Lethbridge Catholic Separate School District #9

In the list that follows each skill has a corresponding behaviour or two typical of a child using the particular HIS.

1. **Abstracting**: Jessie wrote a précis. Shasa said, "the bottom line is . . . ." Shasa said, "The essence of *War and Peace* is . . . ."

2. **Analysing**: Claire breaks the process of preparing a piece of wood into a number of distinct steps.

3. **Applying**: Kim says, "Please" and "Thank you" without prompting. I observed Nat offer a prayer for another student. Kelly practised the lay-up after a demonstration by the teacher.

4. **Assuming**: Bertie often introduces her remarks with, "I assume that . . . ."

5. **Changing Point of View**: Chris speaks when asked, "How do you think he feels now?" Tracey says, "Look at it from this point of view." On reading a story, Lori says, "that makes me feel sad."

6. **Checking**: Milly says "Is that it?" Mikey examines the work done according to the requirements of the assignment. Tim looks for completeness.

7. **Classifying and Categorizing**: Tosh grouped the cattle into beef, dairy, rodeo, pets and show.

8. **Clarifying**: Timmi said, "What you seem to be saying is . . . ." Timmi also says, "If I get you right, you mean . . . ."

9. **Communicating**: Kelly tells the class about a trip to Disneyland and answered questions.

10. **Comparing**: Jaimie observed in class that dairy cows and beef cows both have udders and they chew their cud.

11. **Computing**: Georgie determined the distance between Banff and Saskatoon using a map.

12 **Concentrating**: Jody nods when listening to a speaker, sometimes makes notes and works on the task at hand.

13. **Creating**: Standish developed seven different uses for a clothes hanger. Standish makes puns.

14. **Contrasting**: Toni reported that beef cows have a rectangular body while dairy cows have a somewhat triangular body shape.

15. **Criticizing**: Jon was able to list all the plus, minus and interesting features of the video they viewed.

16. **Deciding**: Kelly looked at the options for the math project and chose the fifth one.

17. **Defining**: Alex often speaks like this, "A solid is . . . ."

18. **Demonstrating**: Gillian showed the class how to operate the bunsen burner. Students will say, "Let me show you . . . ."

19. **Describing:** Pat says, "A barn owl is a bird with no tufts on its head. It eats mice and small birds. It says, too whit – too whoo."

20. **Discovery:** Shannon often says, "Do you know what I found?" or "Look what I found!" or "I never knew that. Is that ever neat!"

21. **Discriminating:** Kristi can tell the difference between musical instruments by listening carefully to their sounds.

22. **Discussing:** Joe shares ideas freely with the group; Joe exchanges ideas with others.

23. **Distinguishing:** Frankie separates the squares from the circles. Frankie explains the differences between capitalism and communism.

24. **Dramatizing:** Jackie participates in role play. Gerry uses actions to explain the poem. Tracy showed the class how the prairie chicken dances.

25. **Drawing:** Tony's pictures tell a story. Terry makes diagrams of ideas.

26. **Enjoying:** Patrice told the teacher how much they all liked the class play.

27. **Estimating:** Toby looked into the room and said, "I think there are about 12 people." "I heard Win say, It is so cold, the river will probably freeze over by morning."

28. **Evaluating:** From time to time, Biff says, "This is important to me."

29. **Experimenting:** Joni put an egg in vinegar to see what would happen.

30. **Explaining:** Devin told the group the steps involved in completing the assignment.

31. **Expressing:** Jody makes himself well understood when he speaks and writes.

32. **Extending:** Joni is good at completing a story after being given a story starter.

33. **Generalizing:** Joni has discovered that all triangles have three sides.

34. **Graphing:** Joni plotted and traced information on a diagram.

35. **Logical Reasoning:** Michey asked, "If I finish my story, then I can type it on the computer."

36. **Hypothesis:** Joni comes up with a possible answer to the problem before doing any extensive work on it. "I think the answer is . . . ."

37. **Identify:** Joni can consistently pick out a sphere from a group of shapes.

38. **Imagining:** Joni can think of different uses for everyday objects.

39. **Improvise:** Joni is able to come up with unique ways to use commonplace objects.

40. **Managing:** Terri does not need to go back to her locker to get her exercise books after class has begun.

41. **Manipulating:** Val has started to play the xylophone with both mallets.

42. **Measuring:** Freddy weighted 1.5 kilograms of chicken for the diet recipe.

43. **Memorizing:** Gerry can recite the multiplication tables. He remembers the names of the Great Lakes helped by word HOMES.

44. **Model-Making:** Shawna and Johnny created a 3D representation of the Oldman River Valley in Lethbridge.

45. **Observing:** Mark looked at and recorded the noon temperature for five consecutive days.

46. **Organizing:** Sal records the day's assignments in the journal.

47. **Participating:** Syl joins class discussions and most physical activities.

48. **Patterning:** Lee writes poetry and creates symmetrical designs using pattern blocks.

49. **Planning:** Joey makes an outline before starting his library research.

50. **Predicting:** Based on news reports, Chris opened that the white dominated government of South Africa will vanish within five years.

51. **Questioning:** To almost every class, Lou makes enquiries regarding the subject at hand.

52. **Reasoning:** Dani said, "Because I watered my plant with a solution of glue and water, it died."

53. **Recall:** Alex was able to list the sequence and dates of the War of 1812 from memory.

54. **Reflecting:** During journal writing time, Chris wrote thoughtfully about the events of the day.

55. **Resolving:** After considering the effects of smoking, Allie decided never to smoke.

56. **Restating:** Marty said, "When you say the book is indigo, you are saying it is a shade of blue."

57. **Simplifying:** Barney rewrote the rules of Monopoly to make them easier for the Grade Two students to read and understand.

58. **Sorting:** Alf put the large buttons in one box and the small ones in another. Alfie separated the bases from the acids.

59. **Symbolizing:** Jen drew clouds with rays of sun shining out to represent belief in God.

60. **Synthesizing:** Jean gathered information from many different sources before writing a composition on Confederation. Jean combined the techniques of several impressionist artists to create his own style.

61. **Verifying:** Michel proved that the subtraction problem was correct by reversing the process and checking it by adding.

GUIDING PRINCIPLES FOR TEACHING THINKING

1. Students can improve their thinking skills.

Thinking – how should I define it? It is a soundless dialogue, it is the weaving of patterns, it is a search for meaning. The activity of thought contributes to and shapes all that is specifically human.
John Steiner

In the fullest sense of the word a "student" is anyone who learns. While students vary in their abilities, students of all ages can improve their thinking. The latter is particularly true if the methods and materials of instruction are attuned to the students' developmental needs.

Some students may be inefficient thinkers or may lack knowledge of particular strategies. They may not be aware that they do not understand material that they read; they may not apply the most effective thinking strategies for the task at hand; or they may be struggling with the organizational skills to decide where or how to begin a task. Lack of knowledge of particular strategies and inefficient thinking hinders students not only in the classroom, but in their lives. Research indicates that teaching thinking skills can help students overcome such obstacles.

2. Students should have opportunities to improve their thinking skills.

Educators say without a major effort to teach students how to apply what they've learned, millions may find themselves unprepared for the increasingly complex and technological future.
Association for Supervision and Curriculum Development

We all face similar challenges and opportunities as we move toward the twenty–first century. Ours is a world characterized by change and complexity. Only 15 years ago a calculator that performed addition, subtraction, multiplication and division, was an expensive electronic wonder. Now calculators capable of even greater mathematical feats are given away free as promotional gimmicks. The rapid technological advances of the past decades in such diverse areas as computer applications, genetics and nuclear physics have resulted in difficult ethical questions which society will need to address. Today's students are the future lawmakers, parents and voting citizens and it will be their task to make wise decisions in the face of many changes. To undertake this task students will need to develop individual and collaborative decision–making skills.

Along with the challenges presented by rapidly changing technologies are the challenges of what is so often called the "information age." The majority of today's students will be working in some way with processing and communicating information. Students will need thinking skills that enable them to continue to process these ever–expanding bodies of information.

Teach the children to think.
Isaac Newton

In such a changing world, successful living means developing and improving thinking skills. It means developing abilities to gather information, to solve problems, to explore and express ideas creatively. Children start school with a repertoire of thinking skills. It is up to us to ensure that they have opportunities to refine these skills and to learn new ones.

The only way in which a human being can make some approach to knowing the whole of a subject, is by hearing what can be said about it by persons of every variety of opinion, and studying all modes in which it can be looked at by every character of mind.
John Stuart Mill

3. Educators should instruct students in thinking skills.

Teaching thinking is best done through ongoing interaction. In this interaction, students actively discover meanings. Thinking is stimulated, valued, expected and required. Ideas are shared and challenged. Teachers actively model thinking skills – making use of strategies and approaches that invite students to think. What is vital in this interaction is that the teacher be aware of the thinking skills being modeled and that these skills be made explicit to students.

4. Educators should use a range of strategies in teaching thinking skills.

The really valuable thing is intuition.
Albert Einstein

To teach thinking is to teach a range of skills. That range includes, but is not limited to: analysing arguments, generating insights, developing new ideas and building on existing ones, making decisions, solving problems and making use of strategies in learning. Any one of these skills might serve as an excellent starting point in teaching thinking.

Each teacher, each program of studies, presents an opportunity to expand students' thinking. Students need to know that what they are learning (in a subject or from a teacher) represents an approach to thinking. Knowing this, they can begin to appreciate the possibilities and limits of that approach as well as realize that it is one of several approaches available to them.

Students who are aware of how they think and of the tools they can use to facilitate thinking, have a choice. In short, they are empowered to be independent learners.

5. Educators should make use of life experiences and school subjects in teaching thinking skills.

When faced with a thinking situation many children have no confidence because they have no practice.
Edward de Bono

Since it is impossible to think without thinking about something, thinking skills are best encouraged when integrated in programs of study. This approach to the teaching of thinking skills needs to be an explicit part of lessons. As these lessons help students to become more conscious of their own thinking, students can transfer skills between school subjects and beyond school settings. Many teachers encourage this transfer. In classrooms, students are made aware of the reasons for applying certain learning thinking strategies to specific tasks. Students are given the opportunity to practice specific strategies, are presented with the chance to use these strategies in various ways, have become autonomous users of these strategies through teacher encouragement and modelling, and have persisted in their own efforts to learn.

6. Educators should have opportunities to learn about thinking as well as how to teach thinking.

Teaching thinking is as complex as teaching any other subject matter. If you are required to teach chemistry, it would be assumed that you should know the subject area well. The same applies to the teaching of thinking. This, together with preparation, commitment, and hard work, is required if thinking is to be taught effectively. It would be expecting too much to ask educators to teach thinking well without offering them adequate preparation and support for the task.

You do not like them
So you say.
Try them! Try Them!
And you may.
Try them and you
may, I say.
From Green Eggs and Ham by Dr. Seuss

Educators need opportunities to be aware of their own mental processes and of skills and strategies appropriate to the subjects they teach. It is our belief that thinking skills should not be taught as isolated skills but as an integrated part of subject material. Curriculum developers should provide leadership by exemplifying effective thinking and universities by demonstrating sound strategies for teaching thinking.

7. Educators should use appropriate evaluation techniques to assess thinking skills.

Ideally, the evaluation of thinking skills will occur on at least three levels. If students are to be aware of their own cognitive processes, then it is appropriate that students be involved in their own evaluation. The educator, who is already involved in evaluating the student for the subject content, must also be involved in evaluating the students' thinking skills. Finally, teachers must be involved in evaluating strengths and weaknesses, both individual and collective.

Above all, I shall then be able to continue my search into true and false knowledge. I shall find out who is wise, and who pretends to be wise, and who is not.
Socrates

Students should be encouraged to be active participants not only in the learning process, but in evaluation as well. Thinking about thinking, or metacognition as it is now often called, is, in fact, one form of ongoing self-evaluation in which the student continuously monitors and evaluates the effectiveness of his or her thinking. When students question and review their work, restate, edit and reread what they have written, or regulate their use of time and resources, they are also evaluating the thinking processes they have used.

In evaluating the student, the educator assesses cognitive development and then works with the student in identifying ways to enhance that development. Observing, conferencing, collecting language samples, using students' reports such as questionnaires, journals, checklists, and written self-analyses, are just some of the many techniques that can help teachers develop an over all impression of students' thinking skill development. The gathering of information by teachers should be an eclectic and continuous process which is integrated throughout programs of study.

It is inconsistent to encourage thinking in the classroom and discourage it on tests.
Allan Glatthorn

The Student Evaluation and Records Branch of Alberta Education addresses the inclusion of thinking skills in provincial assessments of students' growth and development. Provincial achievement tests stimulate inquiry and critical reasoning by asking students to identify bias, recognize cultural uniqueness and appreciate various points of view. Within particular programs of study, students are challenged to apply their knowledge to real-life situations and to synthesize and explore ideas. The Student Evaluation and Records Branch will continue to use innovative assessment strategies to monitor students' thinking skills.

The assessment of thinking skills should be extended beyond classrooms and achievement tests to involve the entire school community in ensuring acceptable standards are set and being met. All the stakeholders in our schools need to have the opportunity to share ideas, to reflect on their own thinking and to discuss the thinking skills promoted in this paper and realized in the classroom.

8. **Administrators can and should ensure positive attitudes toward thinking in schools.**

The development of thinking within classrooms cannot take place without administrative support. Administrators support thinking when they create intellectually stimulating school conditions, develop the vision of a school which fosters thinking and challenge teachers and students to think creatively, critically and reflectively. Open discussion among participants in the school – parents, teachers, administrators, bus drivers, office staff and community members – is essential in creating an environment where thinking flourishes.

9. **Alberta Education should make explicit the teaching of thinking skills in curricular documents.**

Teaching thinking will be most effective if we invite students to do as we say and as we do. Curriculum documents, programs of study and support materials which help to guide the day-to-day activities in the classroom must embody good thinking and sound strategies for teaching thinking.

He is a thinker; that means, he knows how to make things simpler than they are ...
Friedrich Nietzche

Students should be encouraged by the teacher and resources used in the classroom to reflect upon the ideas and applications of the content presented. As the material encourages students to interact with multiple perspectives – variables in knowledge, strategies and outcome – students will be actively, rather than passively involved with the information presented.

FEEDBACK

THANKS

1. What part of this document is most useful in guiding your involvement in teaching thinking skills?

   _____

   _____

   _____

2. Are there principles or practices you would add? _____

   _____

   _____

3. Are there other directions or initiatives related to this document that you would like to see developed by Alberta Education? _____

   _____

   _____

4. Other comments and suggestions: _____

   _____

   _____

   _____

Thank you for your feedback! Kindly complete the following:

You are a
- ☐ teacher (please specify level) ECS–Gr. 6; Gr. 7–9; Gr. 10–12
- ☐ school administrator (please specify level) ECS–Gr. 6; Gr. 7–9; Gr. 10–12
- ☐ system administrator
- ☐ other reader (please specify) _____

Please send your response to:

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